STAR

JULY 23, 1967

VOLUME 5 • NUMBER 14

N67-26481—N67-27780

DOCUMENTS DEPT.

AUG 25 1967

Duke University Library

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PURCHASE OF *STAR*

The semimonthly issues and the cumulative index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, United States Government Printing Office, Washington, D.C., 20402, United States of America.

Semimonthly issues . . .

Annual subscription rate: $33.00, domestic; $42.00, foreign. Price per single copy: $2.25, domestic; 25¢ extra for foreign mailing.

Cumulative index issues . . .

Annual subscription rate: $30.00, domestic; $35.00, foreign. Price per single copy varies according to the number of pages.

Domestic subscription rates . . .

Apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

Foreign subscription rates . . .

Apply to Argentina, Brazil, British and French Guiana, Surinam, British Honduras, and all other countries throughout the world.

Payment should be by check, money order, or document coupons, and must accompany order. Remittances from foreign countries should be made by international money order, or draft on an American bank, payable to the Superintendent of Documents, or by UNESCO book coupons.

PUBLISHED BY:
UNITED STATES GOVERNMENT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

Scientific and Technical Aerospace Reports, Volume 5, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966.

Introduction

WHAT *STAR* IS

Scientific and Technical Aerospace Reports (STAR) **is a comprehensive abstracting and indexing journal covering worldwide report literature on the science and technology of space and aeronautics. It is published twice each month.**

Major areas covered in *STAR* are:

Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

HOW *STAR* IS ORGANIZED

The first section of *STAR*, arranged in 34 categories, contains abstracts and bibliographic citations. A second section consists of five indexes: subject, author, source, report/accession number, and accession/report number. Separate cumulative indexes are published quarterly, the fourth quarterly being an annual index for the calendar year. Cumulative indexes also contain a contract number index.

HOW TO USE *STAR*

Readers are encouraged to examine the abstracts in each category of interest. If time is short, and when interest is concentrated in specific areas, readers may wish instead to scan source, author, and subject indexes. A more thorough coverage of a subject field may often be achieved by detailed examination of the subject listings, especially as they are cross-indexed in the quarterly indexes.

AVAILABILITY OF *STAR* AND DOCUMENTS

NASA documents (identified by an asterisk), as well as *STAR* itself, are available without charge to:

1. **NASA Offices, Centers, contractors, subcontractors, grantees, and consultants.**
2. **Other U.S. Government agencies and their contractors.**
3. **Libraries in the United States that maintain collections of NASA documents for public reference.**
4. **Other organizations in the United States having a need for NASA documents in work related to the aerospace program.**
5. **Foreign government or academic (university) organizations that have established reciprocal arrangements for the exchange of publications with NASA, that have current agreements for scientific and technical cooperative activities with NASA, or that have arrangements with NASA to maintain collections of NASA documents for public use.**

Department of Defense documents (identified by the "AD" number in the citation) are available without charge to U.S. Government-sponsored research and development activities from the Defense Documentation Center (DDC), Cameron Station, Alexandria, Virginia 22314. Department of Defense documents are not available from NASA.

Other non-NASA documents are provided by NASA without charge only to NASA Offices, Centers, contractors, subcontractors, grantees, and consultants. Foreign non-copyrighted documents will be provided to U.S. Government Agencies and their contractors. AGARD reports that are not commercially available will be made available on the same basis as NASA documents.

Documents that have been placed on microfiche are identified with the symbol #. Microfiche are available on the same basis as hard-copy.

HOW TO REQUEST LISTED DOCUMENTS

If you are registered with NASA, send a completed *Document Request* (Facility Form 492) to:

NASA Scientific and Technical Information Facility
P. O. Box 33
College Park, Maryland 20740

If you are not registered with NASA, but are eligible to receive documents without charge according to the information on the previous page in the section on Availability of *STAR* and Documents, request Registration Form—Technical Publications (Facility Form 713) from the above address.

HOW THE PUBLIC MAY OBTAIN LISTED DOCUMENTS

For reference purposes, NASA documents listed in *STAR* may be consulted at one of the organizations listed on the inside back cover. Commercial publications listed in *STAR* may be consulted in libraries or purchased from publishers or booksellers.

The public may purchase NASA documents and non-copyrighted foreign documents listed in *STAR* from either of two sales agencies, specifically identified in the abstract section:

Clearinghouse for Federal Scientific and Technical Information
(CFSTI)
Springfield, Virginia 22151

Superintendent of Documents, U. S. Government Printing Office
(GPO)
Washington, D. C. 20402

Documents available from CFSTI are sold in hard copy and microfiche form. If a printed hard copy is not available, a facsimile copy is provided. The symbols "HC" and "MF" are used in the abstract section to designate the copy available: "HC" (hard copy) for full size or facsimile; "MF" for microfiche. A unit price policy has been established by CFSTI: $3.00 for printed hard copy or facsimile copy; $0.65 for microfiche.

Not all NASA documents, however, are subject to this policy. Documents available from Superintendent of Documents which are also available from CFSTI are sold at the Superintendent of Documents price, and other selected NASA publications will continue to be priced according to previous practices. In all cases, the *STAR* citation includes the specific sale price which applies.

Following the availability information in the citation of each NASA-supported document is a code, e.g., CSCL 25A, indicating the subject category assigned to that document from the *COSATI Subject Category List* (first ed., December, 1964) published by the Committee on Scientific and Technical Information of the Federal Council for Science and Technology.

The public may request non-NASA documents by writing to the source or other information systems. Identification other than the NASA accession number (i.e., N67-12345) should always be provided when requesting such a document from its source.

ABSTRACTS OF JOURNAL ARTICLES

By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses subject categories identical with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

Organizations having a NASA contract may obtain *IAA* by writing NASA, Code USS-A Washington, D. C. 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N. Y. 10017.

01 A

02 A

03 A

04 BI

05 BI

06 CI

07 CO

08 CO

Volume 5 Number 14 / July 23, 1967

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories: *page:*

01 AERODYNAMICS
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **2443**

02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **2445**

03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **2447**

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **2450**

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **2466**

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **2474**

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **2485**

08 COMPUTERS
Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **2495**

09 ELECTRONIC EQUIPMENT
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **2504**

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **2507**

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **2510**

12 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **2515**

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **2520**

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **2529**

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, reliability; drafting; and materials fabrication, handling, and inspection. **2541**

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **2547**

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. **2550**

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **2559**

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. **2561**

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. **2567**

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. **2569**

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. **2573**

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. **2580**

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. **2583**

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. **2594**

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. **2601**

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. **2605**

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. **2606**

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. **2608**

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. **2610**

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **2617**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **2621**

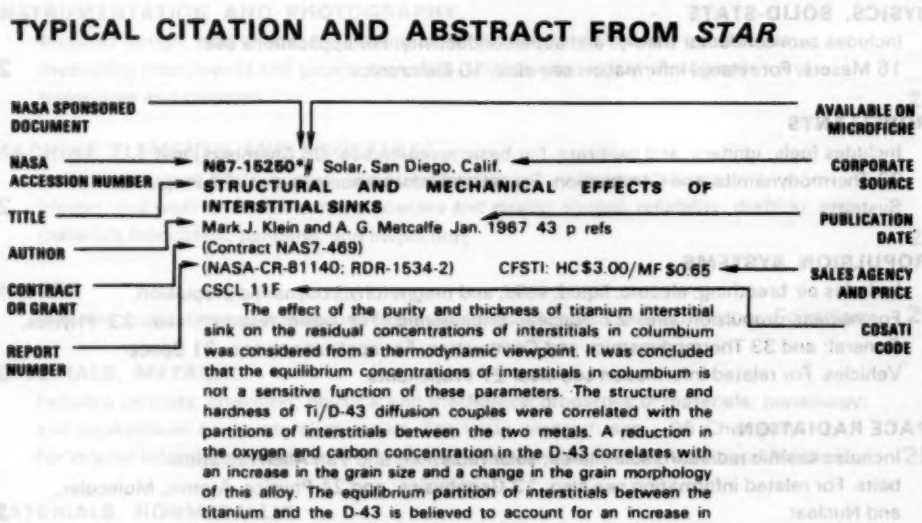
33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **2630**

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. **2634**

TYPICAL CITATION AND ABSTRACT FROM *STAR*


NASA SPONSORED DOCUMENT
AVAILABLE ON MICROFICHE
NASA ACCESSION NUMBER
N67-15250*# Solar, San Diego, Calif.
CORPORATE SOURCE
TITLE
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
PUBLICATION DATE
AUTHOR
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
CONTRACT OR GRANT
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
SALES AGENCY AND PRICE
CSCL 11F
COSATI CODE
REPORT NUMBER
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

VOLUME 5 NUMBER 14 / JULY 23, 1967

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N67-26558*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT EVALUATION OF SPLITTER-PLATE EFFECTIVENESS IN REDUCING BASE DRAG AT MACH NUMBERS FROM 0.65 TO 0.90

Edwin J. Saltzman and John Hintz Washington, NASA, May 1967 23 p refs

(NASA-TM-X-1376) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An experiment has been conducted to determine the effectiveness of a splitter plate in reducing base drag at subsonic speeds. The test configuration was a fin-like shape which may be representative of blunt trailing-edge stabilizing surfaces of future hypersonic aircraft or reentry vehicles. The test chord Reynolds numbers, up to 36.2×10^6, are believed to be representative of chord Reynolds numbers for the terminal, subsonic phase of a lifting body reentry. The splitter plate, which extended into the wake region a distance of 1 base width, reduced the negative base pressure coefficients between 30 and 40 percent. This increment in base pressure coefficient was as large as obtained on a two-dimensional wind tunnel model at the higher comparable Mach numbers and about 12 percent lower at the lower comparable Mach numbers, even though the flight results represented higher Reynolds numbers and contained outboard end (three-dimensional) effects. Author

N67-26637*# National Aeronautics and Space Administration, Washington, D. C.

ANALYTICAL STUDY OF SPIN [ETUDE ANALYTIQUE DE LA VRILLE]

M. Scherer and M. O. Aguesse (ONERA, Chatillon, France) May 1967 12 p refs Transl. into ENGLISH from French Presented at the AGARD Meeting on Stability and Control, Cambridge, Gt. Brit., 20–23 Sep. 1966

(NASA-TT-F-10902; ONERA-TP-388) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The aerodynamic parameters were obtained from analytical wind tunnel measurements of the constant and variable derivatives, performed on the same model and used as basis in the calculation of aircraft motion, programmed on a digital computer. The object of these first calculations was to conform the free-spin results obtained in the vertical wind tunnel on a delta-60 aircraft model. The results obtained are analyzed and discussed. Author

N67-26917# Mithras, Inc., Cambridge, Mass.

WIND TUNNEL MEASUREMENTS OF TURBULENT WAKE COOLING WITH BASE INJECTION Scientific Report, 1 Feb.–31 Jul. 1966

Jacques A. F. Hill and Richard W. Luce Aug. 1966 60 p refs

(Contract AF 49(638)-1494)

(AFOSR-66-1929; MC-64-85-R3; AD-647954) CFSTI: HC $3.00/MF $0.65

Wind-tunnel measurements of the turbulent wake flow behind a slender body at M = 8 were made with and without fluid injection from the base. Helium and nitrogen were injected at temperatures about one-half of the tunnel stagnation temperature. The maximum injection rates were 0.8 percent and 4 percent respectively of the freestream flow swept out by the model base area. Two injector configurations were used, to obtain either subsonic or supersonic injection velocities. The wake measurements consisted of pilot pressure, cone surface pressure, total temperature and helium mass fraction. They were reduced to velocity and static temperature profiles along and across the wake. The results show a strong dependence of static temperature on injection velocity. With nitrogen injection at a given rate, substantial cooling can be accomplished with supersonic injection while subsonic injection in general actually raises the wake temperature. The nitrogen flow rates required to achieve a given reduction in static temperature are 4-5 times larger than for helium. A theory for fully turbulent base flows is described which predicts quite well the variation with injection rate of the total temperature in the wake neck. Author (TAB)

N67-26941# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.

AN EXPERIMENTAL EVALUATION OF A TWO DIMENSIONAL TURNING PASSAGE AT $M_\infty = 8.0$

Robert J. Cresci and Arthur J. Schlesinger Wright-Patterson AFB, Ohio, ARL, Nov. 1966 53 p refs

(Contract AF 33(657)-8286)

(PIBAL-849; ARL-66-0223; AD-648866) CFSTI: HC $3.00/MF $0.65

The report presents an experimental study of a two-dimensional turning passage designed for a free stream Mach number of 8.0. A row of two blades and two end blocks are combined to form a three passage cascade which is tested at a free stream Reynolds number of 1,500,000 based on the chord length. The blade leading edge bluntness is varied to determine the effect on the overall flow in the blade passages, and in addition, a shock generator is placed upstream of the model to produce a non-uniform free stream flow. The overall effects of these parametric variations on surface pressure distribution, heat transfer, and pressure recovery are obtained for the various test configurations. Author (TAB)

N67-27041# Texas Univ., Austin. Dept. of Aerospace Engineering.
INVESTIGATION OF CIRCULATION CONTROL AIRFOILS BY MEANS OF JETS Final Report, 1 Jul. 1964–30 Jun. 1966
S. W. Yuan, J. C. Westkaemper, L. D. Kemp, and W. L. Richter, Jr. Nov. 1966 107 p refs
(Contract DA-44-177-AMC-200(T))
(USAAVLABS-TR-66-72; AD-648872) CFSTI: HC $3.00/MF $0.65

Based on the potential flow theory calculation, the capacity of the air supply, the limitation of the internal pressure of the model and the limitation due to the compressibility effect of the jet stream at high velocities, the elliptical airfoils of 18- and 12-percent-thickness ratios were designed and constructed. Experimental investigations for both models with trailing edge jets include force (lift and drag) and pitching moment measurements. In addition, static pressure measurements were made in both spanwise and chordwise directions. These results were used to compare with available theories. Circulation control with dual jets for the elliptical airfoil of 18-percent-thickness ratio was tested with very satisfactory results. Tests were also made to determine the practicality of circulation control using a jet issuing from the leading edge region of the airfoil. The determination of the aerodynamic response of the airfoil model to cyclic changes in jet mass flow was also made. The cyclic results were very satisfactory and are presented in the form of pulsating lift coefficient, drag coefficient, and pressure coefficient as a function of pulsating jet coefficient. Author (TAB)

N67-27199# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Porz (West Germany). Institut fuer Angewandte Gasdynamik.
MEASUREMENTS ON SLOTTED SPOILERS IN SUPERSONIC FLOW [MESSUNGEN AN GESCHLITZTEN SPOILERN IM UEBERSCHALLBEREICH]
E. Stanewsky Feb. 1967 86 p refs In GERMAN; ENGLISH summary
(DLR-FB 67-08; DVL-590) CFSTI: HC $3.00/MF $0.65

Using slotted spoilers arranged normal to the flow direction on a flat plate, the pressure distribution on the base plate and the additional drag arising from the spoiler were measured at Mach numbers 1.57, 1.83, 2.21, and 2.80. The height of the spoiler and the width of the slot were varied so that the change of the aerodynamic coefficients could be determined as function of these parameters. The present results permit to define the field of application of slotted spoilers. The increase of lift obtained compared with that of a solid spoiler, is accompanied by a rise in the drag. The ratio lift to drag approaches a minimum at great slot height. Thereby it follows that the slotted spoiler can be used where the obtained lift may be joined with high drag. In addition the measurements give information on the process of shock-induced boundary layer separation. Author

N67-27271*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION OF THE STATIC AERODYNAMIC CHARACTERISTICS OF AN 18-FOOT (5.49-METER) ALL-FLEXIBLE PARAWING
Charles E. Libbey, George M. Ware, and Rodger L. Naeseth Washington, NASA, Jun. 1967 37 p refs
(NASA-TN-D-3856) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An investigation has been conducted in the Langley full-scale tunnel to determine the performance and the static stability and control characteristics of an 18-foot (5.49-meter) all-flexible parawing. This parawing had no rigid structural members and utilized only the tension forces produced by the aerodynamic loading to maintain the shape of the canopy. The tests showed that the parawing was longitudinally stable at angles of attack from about 30° to 40°. At lower values of lift–drag ratio, which correspond to angles of attack above 40°, there was a destabilizing break in the pitching-moment curve and the parawing was unstable over the remainder of the test angle-of-attack range (up to 100°). As the angle of attack was decreased below 30°, the nose portion of the wing collapsed, and at an angle of attack near 28° the entire wing collapsed. Differential deflection of the wing tips for lateral control produced positive rolling moments and negative yawing moments over most of the test angle-of-attack range when the lines were changed in a direction to lower the right wing tip. Author

N67-27280*# National Aeronautics and Space Administration, Washington, D. C.
A METHOD OF DYNAMIC PROGRAMMING AND ITS APPLICATION TO OPTIMIZATION PROBLEMS OF FLIGHT MECHANICS
W. Schulz and H.-K. Schulze Jun. 1967 25 p refs Transl. into ENGLISH of the paper "Die Methode des Dynamic Programming und Ihre Anwendung auf Optimierungsaufgaben der Flugmechanik", Presented at the Annual Meeting of Wiss. Ges. fur Raketentechnik und Raumfahrtforschung, Berlin, Sep. 14–18, 1964
(NASA-TT-F-483) CFSTI: HC $3.00/MF $0.65 CSCL 01D

The method of dynamic programming, based on the optimization principle established by R. Bellman, is suitable for the treatment of optimization problems in which—for example, due to the existence of secondary conditions in the form of inequalities—the prerequisities for solution with the classical indirect method of the calculus of variations are not met. On hand of examples of optimization of a multistage rocket and determination of brachistochronic flight paths, practical application of the method of dynamic programming is described. Practical experience with the computational procedure and problems of accuracy are discussed in some detail. Author

N67-27289*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPHERE BEHAVIOR AND THE MEASUREMENT OF WIND PROFILES
James R. Scoggins Washington, NASA, Jun. 1967 61 p refs
(NASA-TN-D-3994) CFSTI: HC $3.00 CSCL 01A

An investigation was conducted to determine the characteristics of the aerodynamic forces which cause spurious balloon motions, and to determine if a smooth superpressure balloon can be modified to eliminate the spurious motions and provide accurate wind profile measurements. Forces associated with aerodynamically unstable balloons were investigated by solving the equations of motion and evaluating individual force terms using high precision radar data obtained by tracking balloons as they ascended through the atmosphere. Among the conclusions are that (1) statistical properties of the motions are predictable, (2) lift and drag forces are nearly symmetrical along the horizontal axes with a mean near zero, (3) distributions of drag coefficients are nearly symmetrical with average values between 0.25 and 0.30, and (4) the lift force is predominantly horizontal, increases in magnitude with balloon size, and is distributed symmetrically in the x and y directions with means near zero. C.T.C.

N67-27290*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DAMPING BEHAVIOR OF DE HAVILLAND STEM BOOMS
R. E. Predmore, C. L. Staugaitis, and J. E. Jellison Washington, NASA, Jun. 1967 17 p refs
(NASA-TN-D-3998) CFSTI: HC $3.00 CSCL 20K

Vibration frequency and damping behavior of STEM (Stored Tubular Expendable Member) booms was studied. The program consisted of (1) a study of the theory of damping mechanisms in metals and alloy systems to predict the results of internal friction and structural damping; and (2) experiments to measure vibration decay rates under vacuum conditions using strain gauge techniques compared with photographic techniques. Damping behavior is discussed in terms of boom orientations, boom length, and the

mechanism responsible for the boom dynamics observed. The magnitude of damping was predicted and found to be small for both the electroplated and bare conditions. The principal damping mechanism of the STEM boom is the frictional damping between the overlapping surfaces of the boom. Electroplated silver was found to reduce the damping because it lubricated the sliding interfaces of the overlap. Author

N67-27530*# International Information, Inc., Philadelphia, Pa.
WIND-TUNNEL STUDY OF A HYPERSONIC LIFTING RE-ENTRY BODY [ETUDE AERODYNAMIQUE D'UN CORPS DE RENTREE PORTANT EN HYPERSONIQUE]
Rene Ceresuela Mar. 1967 28 p refs Transl. into ENGLISH from Rech. Aerospatiale (France), no. 409, 1966 p 9
(Contract NASw-1499)
(NASA-TT-F-10813) CSCL 01A

The O.N.E.R.A. tested a lifting re-entry body up to Mach numbers of 16.5 and angles of attack up to 50°. When compared with Newtonian predictions, the wind-tunnel tests indicate the limitations of the Newtonian theory which does not foresee influence of the blunt nose interaction. The efficiency of conventional elevons was investigated as well as the evolution of the yaw stability as a function of the Mach number and the angle of attack; the good performance of twin lateral fins is explained. The kinetic heating rate distribution at high angles of attack at M=10 measured by thermosensitive paints is discussed. Author

N67-27573*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
ADDITIONAL STUDY AND FURTHER DEVELOPMENT OF THE TRACER-SPARK TECHNIQUE FOR FLOW-VELOCITY MEASUREMENTS. A STUDY OF THE STRUCTURE OF SPARK COLUMNS FOR VELOCITY MEASUREMENT IN A HYPERSONIC STREAM
James B. Kyser Washington, NASA, May 1967 167 p refs
(Contract NsG-620)
(NASA-CR-760) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The experimental part of the study consisted of 1) time-resolved measurements of spark current, temperature, and intensity profile made in a static test chamber over a range of spark energies and ambient static pressures, with nitrogen as the test gas, and 2) measurements of flow velocity in a hypersonic stream made under controlled conditions. During both phases the effects of a magnetic field parallel to the spark axis were investigated. The spark process was also studied analytically on the basis of published data from electron-drift experiments conducted in nitrogen. The measured time-resolved spark current is used as an input in the analysis, and it is shown that good agreement between measured and computed rates of change of temperature is obtained when the computed intensity profile is matched to the measured intensity profile. Author

N67-27616*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
MEASURED AND COMPUTED STATIC AERODYNAMIC CHARACTERISTICS OF ABLATING CONICAL TEFLON MODELS AT MACH NUMBER 14
Leland H. Jorgensen and Jack R. Hagen Washington, NASA, Jun. 1967 34 p refs
(NASA-TN-D-4022) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Axial-force, normal-force, and pitching-moment coefficients were measured for ablating teflon and nonablating metallic pointed 30° half-angle cones, blunted 10° half-angle cones, and blunted 60° half-angle cones with boattail aftersections. For moderate mass-loss rates up to about 4 percent of the free-stream mass intercepted by the model and with laminar flow, there were no appreciable effects of ablation on the forces and moments. The axial-force coefficients for the 30° half-angle cones were affected the greatest, but they decreased only about 5 percent with ablation throughout the angle-of-attack range studied (0°–20°). The forces and moments for the pointed 30° half-angle cones were adequately predicted with Newtonian theory. However, for the blunted 10° half-angle cones the predicted axial forces were too large and the centers of pressure more rearward (by about 0.15 diam) than measured. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N67-26545*# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.
THE INFLUENCE OF RESPONSE FEEDBACK LOOPS ON THE LATERAL-DIRECTIONAL DYNAMICS OF A VARIABLE-STABILITY TRANSPORT AIRCRAFT
Kenneth J. Szalai Washington, NASA, May 1967 47 p refs
(NASA-TN-D-3966) CFSTI: HC $3.00/MF $0.65 CSCL 01C

The range of feedback gain for which approximate expressions are valid in describing the effect of a particular loop is noted. The root-locus method is used to show how the Dutch roll, roll, and spiral modes are influenced as a function of feedback gain. Expressions are developed which directly relate feedback gains to some response parameter, such as Dutch roll frequency, damping ratio, or roll and spiral mode time constants. The expansion to multiloop systems is discussed, along with limitations of the response feedback system, from the standpoint of operating a variable-stability aircraft. Author

N67-26811# General Precision, Inc., Binghamton, N. Y.
A PROTOTYPE PERIPHERAL VISION AIRCRAFT ATTITUDE DISPLAY
William R. Williamson Wright-Patterson AFB, Ohio, AF Flight Dyn., Lab., Oct. 1966 21 p refs
(Contract AF 33(615)-2895)
(Rept.-64-132; AFFDL-TR-66-91; AD-648585) CFSTI: HC $3.00/MF $0.65

An instrument is described for presenting attitude information to the pilot in such a manner that he may maintain an awareness of his attitude through peripheral vision without the necessity for looking directly at a specific instrument. The system does this by projecting a line of light on the aircraft instrument panel and moving it in a manner similar to the motion of the real horizon. A design criteria and a detailed engineering description of the working model are also presented. Author (TAB)

N67-26957# Boeing Co., Morton, Pa. Vertol Div.
GENERALIZED ROTOR PERFORMANCE
E. Kisielowski, R. Bumstead, P. Fissel, and I. Chinsky Feb. 1967 125 p
(Contract DA-44-177-AMC-143(T))
(USAAVLABS-TR-66-83; B-390; AD-648874) CFSTI: HC $3.00/MF $0.65

The report presents a summary of generalized rotor performance charts suitable for preliminary design in the rotary-wing field. Generality is achieved by nondimensional presentation of power requirements over the complete range of rotor lift and propulsive requirements for a wide spectrum of speed conditions.

Lines of constant power are shown on a lift-drag coordinate system for each speed condition, providing a useful tool in the development of rotored aircraft configurations. Techniques are presented for employing the charts in a variety of design problems, including the compound helicopter, where the optimum combination of rotors, wings, and auxiliary propulsion devices is desired. Author (TAB)

N67-27126 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany).
REPORT ON THE MEETING OF THE SCIENTIFIC COMMITTEE ON "ROTATING WING AIRCRAFT AND PROPELLERS" ON FEBRUARY 25TH, 1966 AT MUNICH. SUBJECT: OSCILLATIONS OF HELICOPTER ROTOR BLADES [BERICHT UBER DIE SITZUNG DES FACHAUSSCHUSSES DREHFLUGELFLUGZEUGE UND LUFTSCHRAUBEN AM 25. FEBRUAR 1966 IN OTTOBRUNN BEI MUNCHEN THEMA: ROTORBLATTSCHWINGUNGEN]
15 Oct. 1966 214 p refs In GERMAN; ENGLISH summary
(DLR-MITT-66-16)

A general review introduces the problems of calculating oscillations of helicopter rotor blades, presents a method of using analogue computers for calculation of blade oscillations, derives a method by dividing the rotor blade in a system of several oscillating singular masses, and applies transfer matrices. Another matrix method developed by the institute is employed for calculation of natural modes of rotor blade oscillations. Author

N67-27178# California Univ., Berkeley. Inst. of Transportation and Traffic Engineering.
ALLOCATING THE COSTS OF ALLEVIATING SUBSONIC JET AIRCRAFT NOISE
Paul K. Dygert Feb. 1967 27 p refs Supported by FAA
(AD-648748) CFSTI: HC $3.00/MF $0.65

The problem of aircraft noise around airports contains two principal elements: (1) quiet jet aircraft are and will remain (barring major progress in airframe and engine technology) prohibitively inefficient in terms of payload and revenue-generating capacity; (2) jet airports are and will remain (barring changes in land-use and transportation planning) centers of economic activity, including dense residential development. Conflicts in public policy also appear to have contributed to the noise problem. On the one hand, it is in the public interest to keep noise at as low a level as possible; on the other hand, aircraft become technically less efficient and more costly as they are made quieter. Public policy encourages both a quiet society and the development of more efficient air transportation. Finally, under U. S. transportation policy, airlines are private enterprises, free to make their own business decisions within economic and safety constraints. Since the air carriers do not pay the costs of aircraft noise, they tend to ignore these costs in making business decisions. Author (TAB)

N67-27183# Technology, Inc., Dayton, Ohio.
A HELICOPTER STRUCTURAL FLIGHT LOADS RECORDING PROGRAM
F. Joseph Giessler and Joseph F. Braun Dec. 1966 199 p refs
(Contract FA-65-WA-1329)
(FAA-ADS-89)

A flight loads program was conducted on a civil transport helicopter. The following parameters were measured: airspeed, altitude, longitudinal cyclic stick position, collective stick position, two engine torques, normal acceleration at c. g., yaw angular rate, pitch angular rate, and rotor RPM. Rate of climb, thrust coefficient, and tip speed ratio were calculated. Flight segments of takeoff and ascent, cruise, descent, flare and landing, and hover were used to group the data. Data are presented as time tables, peak count tables, histograms, exceedance curves and probability curves. Author

N67-27294*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT INVESTIGATION OF THE LANDING TASK IN A JET TRAINER WITH RESTRICTED FIELDS OF VIEW
John J. Perry, William H. Dana, and Donald C. Bacon, Jr. Washington, NASA, Jun. 1967 23 p refs
(NASA-TN-D-4018) CFSTI: HC $3.00/MF $0.65 CSCL 01B

A total of 155 landings were made in a T-33A jet aircraft to determine the relationship between the pilot's field of view and his performance of the landing maneuver. The field of view was reduced from unrestricted to a minimum of 0.10 radian (5.7°) horizontal and 0.52 radian (30°) vertical. The pilot's task was to fly a 180° power-on pattern and final approach and land the aircraft on a predetermined point on the runway. Power-off 360° overhead and straight-in approaches were performed by one of the pilots. The quality of the performance of the power-on task was measured by recording touchdown error. Pilot comments were obtained for all flights. Performance of the power-on landing task, as measured by touchdown error, was not appreciably affected by the reduction of the field of view. However, pilot comments indicate that even the smallest restrictions of the field of view adversely affected the performance of the task. Author

N67-27300*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL AERODYNAMIC CHARACTERISTICS AT MACH NUMBERS FROM 0.50 TO 1.19 OF A SUPERSONIC TRANSPORT MODEL WITH A MODIFIED M WING
Edward J. Ray and Robert T. Taylor Washington, NASA, Jun. 1967 75 p refs
(NASA-TM-X-1386) CFSTI: HC $3.00 CSCL 01B

An investigation has been made at Mach numbers ranging from 0.50 to 1.19 in a high speed tunnel to determine the longitudinal aerodynamic characteristics of a supersonic transport airplane configuration, designated SCAT 18, with a modified M wing . Longitudinal stability and control effectiveness characteristics were determined for various combinations of model components and the complete configuration with two different horizontal-tail sizes. The addition of the horizontal tails had only a small effect on longitudinal stability of the configuration because of the extremely high downwash rate in the region of the tail. Reductions in horizontal-tail control effectiveness were apparent at moderate angles of attack as a result of possible reductions in dynamic pressure with increasing angle of attack in the region of the tail. The highest untrimmed lift-to-drag ratio occurring for the model with the larger horizontal tail was 8.6 at a Mach number of 0.98. Author

N67-27372*# Stencel Aero Engineering Corp., Asheville, N. C.
HUMAN SURVIVAL IN AIRCRAFT EMERGENCIES
Charles A. Yost and Ronald W. Oates [1966] 74 p refs
(Contract NASw-1530)
(NASA-CR-84413; Rept.-2) CFSTI: HC $3.00 CSCL 01B

A description and analysis are presented of some concepts for improving the probability of human survival in aircraft emergency conditions. The discussion covers internal and external survival improvement methods; aircraft structural factors; certified air carrier, general aviation, rotorcraft, and military accident statistics, and human tolerances. C.T.C

N67-27432*# Stencel Aero Engineering Corp., Asheville, N. C.
HUMAN SURVIVAL IN AIRCRAFT EMERGENCIES
Charles A. Yost and Ronald W. Oates 26 May 1967 100 p refs
(Contract NASw-1530)
(NASA-CR-84438; IR-3) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Consideration is given to aircraft requirements and human physical limits in a study to improve human survival in an aircraft accident. Internal and external to fuselage survival improvement

methods are discussed, along with aircraft structural factors and certified air carrier accident statistics. Also discussed are general aviation accident statistics, rotor craft accident statistics, military accident statistics, and human tolerances. C.T.C.

N67-27481# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
IMPACT OF RELIABILITY REQUIREMENTS ON FLIGHT CONTROL DEVELOPMENT
Frederick R. Taylor Mar. 1967 28 p refs Presented at NATO-AGARD Guidance and Control Panel, Paris
(AD-648563) CFSTI: HC$3.00/MF$0.65

The advent of high performance aircraft has placed more dependence on automatic flight control functions. Because of this the control system is required to not only be highly reliable but also fail operational to provide maximum safety-of-flight capability. The major impact of these reliability and safety requirements on flight control development is that redundancy will definitely be required for advanced high performance vehicles because it is the only means of obtaining fail operational performance. Design techniques are presented which can be used toward developing completely fail safe aerospace vehicles. Author (TAB)

N67-27471# Systems Analysis and Research Corp., Boston, Mass.
AIR TRAFFIC GROWTH, AIRLINE FINANCES, AND PUBLIC BENEFITS IN RELATION TO THE COST OF NEW PROGRAMS TO ALLEVIATE JET AIRCRAFT NOISE NEAR AIRPORTS
Jan. 1967 135 p refs
(Contract FA-67-WA-1656)
(XG-489-67; AD-647393) CFSTI: HC$3.00/MF$0.65

Effective new programs for coping with aircraft noise problems around airports will probably involve new expenditures. If such costs are passed on to airline traffic, they will affect traffic growth through price elasticity of demand. A 1-percent increase in fares and rates is estimated to decrease traffic by 1.3 percent; a 5-percent increase would reduce traffic by 6.3 percent. Separate elasticities are estimated by major airline groups: -1.28 for domestic trunkline passengers, -1.6 for international passengers, -1.0 for local service passengers, and -1.5 for cargo traffic. The airlines appear to have a comfortable financial future to cover all expenses and a fair return on investment, but not sufficient to pay large additional expenses out of forecast revenues without raising their fare and rate levels. The direct beneficiaries of air transportation -- passengers and shippers -- are the logical persons to pay for noise programs, through the pricing system of airlines and the costs of general aviation flying. TAB

N67-27475# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDY OF A COMPOSITE AUTOMATIC FLIGHT CONTROL SYSTEM BY THE METHODS OF THE THEORY OF INVARIANCE [SVYAZANNOGO AVTOMATICHESKOGO REGULIROVANIYA POLETOM SAMOLETA METODAMI TEORII INVARIANTNOSTI]
L. A. Piontkovskiy 20 Dec. 1966 21 p refs Transl. into ENGLISH from the book "Teoriya Invariantnosti v Sistemakh Avtomaticheskogo Upravleniya" Kiev, 1964 p 270-282
(FTD-TT-65-1962; TT-67-61330; AD-648891) CFSTI: HC $3.00/MF$0.65

The article investigates an automatic control system in which the conditions of autonomy of control and the conditions of invariance of the controlled parameters with respect to external perturbations would be satisfied simultaneously. The author commences by finding those equations which describe a system of automatic control of flight speed and pitching angle of the aircraft by changing engine thrust and the angular deviation of the elevator. The equations of an automatic system of control of the aircrafts longitudinal motion are found in matrix form. From the calculations, it is determined by the author that it is impossible to stabilize the flight altitude and angle of thrust of the aircraft simultaneously with only an elevator. Since, in longitudinal control, at least three coordinates are required, the differential equations of the controlled member and of the control system are obtained in matrix form. The author concludes with an investigation of simultaneously satisfying the conditions of autonomy and invariance for three parameters of the given automatic control system. Thus, the proposed automatic control system for the longitudinal motion of an aircraft solves the problem of simultaneously fulfilling the conditions of invariance and autonomy of control with respect to each of the coordinates individually. TAB

N67-27617*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
STATISTICAL ANALYSIS OF LANDING-CONTACT CONDITIONS FOR THE XB-70 AIRPLANE
Ronald J. Wilson and Richard R. Larson Washington, NASA, Jun. 1967 29 p refs
(NASA-TN-D-4007) CFSTI: HC$3.00/MF$0.65 CSCL 01B

Landing-contact conditions for 71 landings of the XB-70 airplanes are analyzed. Some of the conditions are similar to those that may be experienced by future supersonic vehicles. Results are presented as frequency histograms and cumulative frequency distributions in terms of probability. The landing-contact parameters examined include vertical velocity; indicated airspeed; angles of roll, pitch, attack, and sideslip; and rolling and pitching velocities. Author

N67-27638* Stencel Aero Engineering Corp., Asheville, N. C.
HUMAN SURVIVAL IN AIRCRAFT EMERGENCIES
Charles A. Yost and Ronald W. Oates [1967] 96 p refs
(Contract NASw-1530)
(NASA-CR-84455) CSCL 01B

This data compilation serves to improve the probability of human survival in aircraft emergency conditions in relation to aircraft specifications, interior design, and costs. Covered are commercial aircraft, general aviation aircraft, helicopters, government official transport aircraft, and military aircraft. Accident statistics are depicted graphically and definitions for the most adverse environments in which a human can survive are included. Also defined are aircraft design improvement areas that particularly enhance survival. G.G.

N67-27770# Israel Inst. of Tech., Haifa.
BOTH ENDS OF THE STICK
B. S. Shenstone [1967] 20 p Presented at the 9th Israel Ann. Conf. on Aviation and Astronautics, Tel-Aviv, 22 Feb. 1967; Sponsored by Israel Airlines, Ltd.
CFSTI: HC$3.00/MF$0.65

Aerodynamic problems pertinent to the design and operation of aircraft at both low and high speeds are discussed. Stall, spin, wing dropping, Dutch Roll, deep stall, aileron reversal, flutter, supersonic transition, tuck under, and pitch up problems are discussed with respect to older propeller driven type of aircraft and to supersonic aircraft. Air turbulence and mountain wave factors which easily affect the operational safety of modern aircraft are briefly outlined. It is anticipated that the coffin corner dilemma connected with subsonic jets will not be present in supersonic transports; but cruising speed to stalling speed ratio problems remain. L.S.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N67-26516*# Thermo Electron Engineering Corp., Waltham, Mass.
SURFACE AND ADSORBATE STUDIES Quarterly Report, Sep. 25–Dec. 25, 1963
D. Lieb, S. S. Kitrilakis, and J. H. Weinstein 25 Dec. 1963 33 p
(Contract NAS3-2539)
(NASA-CR-84148; TE41-64; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Consideration is given to experimental studies of the emission characteristics of monocrystalline and polycrystalline thermionic converter electrode materials, with emphasis placed on the effects of cesium and cesium fluoride environments on the work function distribution of the surface under various conditions of coverage. The experimental work makes use of scanners that permit scanning to be performed on surfaces that are in equilibrium with the cesium vapor environment. Two types of scanner have been developed: one is a photoelectric scanner suitable for low temperatures where thermionic currents are small and the other is a thermionic scanner for high surface and cesium reservoir temperatures where thermionic currents are significant. Thermionic scanning of surfaces, in the presence of cesium fluoride, was carried out. Temperature ranges corresponding to both emitter and collector operating conditions were studied in both steady-state and transient operation. Author

N67-26517* Electro-Optical Systems, Inc., Pasadena, Calif.
HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS
Robert F. Austin and Martin G. Klein 10 Dec. 1966 17 p
(Contract NAS3-2781)
(NASA-CR-84147; EOS-4110-ML-30) CFSTI: HC $3.00 CSCL 10A

Continuing research on the development of a hydrogen–oxygen (H_2/O_2) regenerative fuel cell is reported. Primary emphasis was placed on the testing of single cells with matrix structures of pasted potassium titanate (KT)/Teflon membranes sandwiched in KT/asbestos layers in order to extend cycle life. Variables in fabrication techniques of the pasted KT/Teflon membrane were explored in the laboratory. Measurements using reference electrodes were initiated during this period. Author

N67-26568*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EARLY RESULTS FROM THE SOLAR CELL RADIATION DAMAGE EXPERIMENT ON ATS-1
Ramond C. Waddel Apr. 1967 40 p
(NASA-TM-X-55772; X-711-67-176) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The experiment involved the exposure and observation of 30 one by two centimeter solar cells of various types and covered by various kinds of shields as they suffered radiation damage after liftoff. Results so far show that some cells were damaged during launch, presumably from electrons and protons in the Van Allen belts. The results were obtained through two sets of observations recorded during the first 3.28 days after liftoff during which the spacecraft made three near equatorial passages through the radiation belts. Solar cells with 1 mil covers deteriorated slightly while cells with thicker shields were apparently undamaged. A comparison of results from 1 ohm cm p-on-n and n-on-p cells with 10 ohm cm n-on-p cells confirms the improvements made in the radiation resistance of solar cells. R.N.A.

N67-26582*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SPECTRAL RESPONSE MEASUREMENTS OF SOLAR CELLS
William G. Gdula Apr. 1967 30 p Prepared by Electro-Mech. Res., Inc.
(NASA-TM-X-55773; X-713-67-194) CFSTI: HC $3.00/MF $0.65 CSCL 10C

In consideration of the importance from both the fundamental viewpoint and practical application of the spectral response measurements of photovoltic devices, particularly solar cells, a considerable effort has been expended to develop the necessary electro-optic instrumentation required for accurate measurements. In addition, the capability of predicting operating performance characteristics and deriving physical material parameters which are closely related to final performance features, has been refined so that experimental analysis is performed on a routine basis. An outline of the instrumentation description is presented along with experimental results and applications. Author

N67-27001# Naval Ordnance Lab., Corona, Calif. Research Dept.
CHEMOELECTRIC ENERGY CONVERSION FOR NON-AQUEOUS RESERVE BATTERIES Quarterly Report, Jul–Sep. 1966
15 Jan. 1967 39 p refs
(NOLC-701; QR-13; AD-648706) CFSTI: HC $3.00/MF $0.65

Evaluation of cathode matrix materials was begun, with liquid ammonia solutions as electrolytes and m-dinitrobenzene or 2, 4-dinitroaniline as the cathode oxidant. Cathode pads containing carbon and glass fibers, silvered glass fibers, platinized carbon and glass fibers, and other noble metals on carbon with glass fibers were tested. A computer program was developed to provide data analysis of typical battery discharge curves. Machine output includes a summary of performance factors and graphs of potential/time, power/time, capacity, and energy. Study of ammonia battery cell stoichiometry was continued by testing the effect of construction variations on internal operating temperature, pressure, and resistance. The test fixture is illustrated, and the results of two best tests are described. Author (TAB)

N67-27044# Burgess Battery Co., Freeport, Ill.
DEVELOPMENT OF MAGNESIUM WAFER CELLS Quarterly Report, 1 Aug.–31 Oct. 1966
Timothy S. Hungate Feb. 1967 31 p
(Contract DA-28-043-AMC-02135(E))
(QR-2; ECOM-02135-2; Rept.-2; AD-648953) CFSTI: HC $3.00/MF $0.65

Three containers were designed to contain expansion. The first is a metal sleeve with tabs at each end which are folded over and secured. Batteries tested perform well, with little evidence of battery sophistications of the first method and are yet untested. One of the major causes of high temperature failure was traced to the inter-cell connectors. No discharge results are available on improved batteries. Author (TAB)

N67-27095*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ENERGY CONVERSION RESEARCH
In its Res. Lab. of Electron. 15 Apr. 1967 p 217–218 (See N67-27081 14-23)
(Contract F33615-67-C-1148)

Brief technical details are given on the status of research on alkali-metal vapor studies, large nonequilibrium generator, and magnetohydrodynamic (MHD) instabilities. Studies on condensing plasma lead to the conclusion that it will not be feasible to maintain a state of nonequilibrium ionization in a wet vapor. The large nonequilibrium generator was operated twice with a pre-ionizer, and pressure distributions along the channel taken. Performance of the channel appeared to improve slightly with time during the run. Because of this, the second run was made with a fixed-load resistance of 3 ohms, in an attempt to define the time dependence of the performance. A general theoretical study of MHD instabilities is mentioned. R.LI.

N67-27282*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEPOSITION OF ALUMINUM AND SILICON OXIDE ON EPOXY-COATED SUBSTRATES

Ferdinand L. Acampora and Adolph E. Spakowski Washington, NASA, Jun. 1967 18 p refs
(NASA-TM-X-1379) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A method was developed for preparing highly reflective surfaces suitable for concentrating solar energy. Aluminum films 0.06-micron thick were deposited on epoxy-coated magnesium substrates in a glass-enclosed metallizing system. The soft reflective material was covered with a protective layer of silicon oxide. The following factors were considered of prime importance to produce coatings of high optical quality: (1) complete curing of the epoxy resin, (2) careful cleaning and handling of the substrates, (3) cooling of the substrates during the deposition of aluminum and silicon oxide, and (4) depositing silicon oxide at a decreasing rate. Spectral measurements made from 2.5 to 35 microns show that silicon oxide coatings increased the emittance of aluminum films from 0.06 to 0.43 while the normal absorptance remained virtually unchanged. Calculations showed that the increased emittance would decrease the equilibrium temperature of a mirror in space only if the emittance of the back surface of the mirror was less than 0.45. Author

N67-27283*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLUTE AND CATHODE INVESTIGATIONS IN PROPYLENE GLYCOL SULFITE
Richard E. Johnson Washington, NASA, Jun. 1967 10 p refs
(NASA-TM-X-1380) CFSTI: HC $3.00/MF $0.65 CSCL 10C

A screening investigation was conducted to determine the potentialities of propylene glycol sulfite as an electrolyte solvent for high-energy-density batteries. The first series of tests was made to determine which solute produced the most highly conducting electrolyte solution with the aforementioned solvent. Morpholinium hexafluorophosphate, lithium perchlorate, and potassium hexafluorophosphate were the best solutes. A second series of tests was made to find the best cathode for use in a cell with a lithium anode. Cupric nitrate was the best cathode tested, with an open-circuit voltage of 3.85 volts and a current density of 7.1 milliamperes per square centimeter at a cell voltage of 3.00 volts. Tests were next made with a modified Wheatstone bridge. These tests indicated that the impedances of the cells are very high (100 to 300 ohms). Compatibility tests on the more promising systems, such as lithium/lithium perchlorate in propylene glycol sulfite/cupric nitrate trihydrate indicate a shelf life of less than 2 days, while in the same system with lead dioxide substituted for the cupric nitrate trihydrate, the life was more than 2 weeks. However, the more stable systems were composed of heavy metal oxides, such as lead dioxide and vanadium pentoxide, which did not produce so high a voltage or current density as the lighter metal compounds for the test period. Author

N67-27306*# National Aeronautics and Space Administration, Washington, D. C.
STUDIES ON VOLTAIC FUEL CELLS [STUDIEN UEBER BRENNSTOFFKETTEN]
I. Taitelbaum May 1967 25 p refs Transl. into ENGLISH from Z. Elektrochem. (Weinheim), v. 16, no. 9, 1910 p 286-300
(NASA-TT-F-10940) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Various electrochemical fuel cells, including the Jacques and Jungner types, were investigated as to their current yield when operated with different fuels. Tabulated and plotted data are given on sulfates of iron, mercury, vanadium, and thallium as oxygen carriers. The potential of iron and mercury salts was similar to that of sulfur dioxide, while the potential of vanadium and thallium sulfates was more positive and permitted the production of reversibly working oxygen electrodes. Specifically, electrodes of vanadium salt and oxygen showed only minor polarization even at high current strength of about 0.1 amp. Replacement of platinum electrodes by galvanically gilded carbon electrodes is suggested. Author

N67-27361*# Unified Science Associates, Inc., Pasadena, Calif.
GASEOUS ELECTROLYTES FOR BATTERIES AND FUEL CELLS Quarterly Report, Nov. 1, 1966-Jan. 31, 1967
S. Naiditch 31 Jan. 1967 23 p
(Contract NAS7-437)
(NASA-CR-84400; QR-2) CFSTI: HC $3.00 CSCL 10C

Electrode emfs and electrolyte conductivities of one cell were measured with the electrolyte in both the liquid and dense gaseous states, and exploratory electrodeposition studies were initiated. It was anticipated that under conditions in which a metal and hydrogen would be codeposited, the deposit out of the liquid state would be pock marked due to bubble formation, whereas that out of the dense gaseous state should be more continuous. The latter should show up by a more crystalline appearance, since, in the absence of a liquid skin, the hydrogen should escape without blocking portions of the surface by bubble formation. The initial data appear to confirm the expectation that metallic deposits from dense gaseous electrolytes are significantly more crystalline than those from liquid electrolytes. Author

N67-27502*# Bendix Corp., Southfield, Mich. Research Labs. Div.
DEVELOPMENT OF A PNEUMATIC DYNAVECTOR ROTARY SERVOMOTOR Final Technical Report
15 Nov. 1966 62 p
(Contract NAS8-5407)
(NASA-CR-84463; TR-3747) CFSTI: HC $3.00 CSCL 13G

The results of a development program to verify the feasibility of a new rotary pneumatic servomotor concept for gimbal actuators are presented. The new concept, the Dynavector actuator, is an integral high-speed virtual motor and high-ratio transmission without high-velocity mechanical elements. The virtual motor is a positive displacement, negligible inertia, rotating vane motor. The motor output is a bi-directional high-speed rotating force vector. The integral transmission converts the rotating force vector directly into low-speed, high-torque rotary motion ideally suited for directly driving a rotary to linear ball screw transmission. The high torque-to-inertia ratio of the Dynavector represents a significant advancement in high response fluid power servo technology. The conclusions of this study confirm the feasibility of the Dynavector actuator for gimbal actuation. Author

N67-27511*# Naval Ammunition Depot, Crane, Ind.
SPACE CELL TEST PROGRAM Monthly Progress Report, Period Ending 31 Jan. 1967
31 Jan. 1967 179 p
(NASA Order W-11252-B)
(NASA-CR-84477) CFSTI: $3.00 CSCL 10C

The results of life cycle and capacity tests, including failure analyses, on 5 and 10 cell packs of nickel-cadmium, silver-cadmium, and silver-zinc batteries are tabulated. R.N.A.

N67-27514*# Gulton Industries, Inc., Metuchen, N. J. Alkaline Battery Div.
DEVELOPMENT OF PILE TYPE, HIGH DISCHARGE RATE NICKEL-CADMIUM SQUIB BATTERIES Third Quarterly Report, 5 Sep.-4 Dec. 1966
S. Charlip and T. Staub [1966] 18 p
(Contract NAS5-10160)
(NASA-CR-84470) CFSTI: $3.00 CSCL 10C

The work and results accomplished during the past quarter in a program directed toward the design and development of a pile type, nickel-cadmium, squib battery are summarized. Five-cell, pile type, nickel-cadmium batteries gave satisfactory performance when a sound seal was maintained between cells. Mechanical sealing with "O" rings and "quad" rings, followed by encapsulation with potting compounds, was unsatisfactory. Reliable seals were produced using adhesive bonding between the nickel substrate

and uncured neoprene. The bond was formed during the vulcanization of the neoprene under heat and pressure. The proper cleaning and conditioning of the electrodes' nickel surfaces is an important factor in achieving reliable bonds. Author

N67-27594# Argonne National Lab., Ill.
TESTS OF COMMUTATING BRUSHES FOR USE IN D.C. MOTORS OPERATING IN A DRY ARGON ATMOSPHERE
M. A. Slawecki, G. J. Bernstein, and L. F. Coleman Dec. 1966 15 p refs
(Contract W-31-109-ENG-38)
(ANL-7262) CFSTI: HC $3.00/MF $0.65

Tests of commutator brushes for use in dc motors operating in a dry argon atmosphere were made to determine the best brush material for minimum wear and the effect on brush wear of moisture and oxygen in the cell atmosphere. The dc motors used were the same type as used for driving the Fuel Cell Facility manipulators. The lowest wear rate was obtained with a resin-bonded carbon–graphite brush containing 5% molybdenum disulfide (Stack-pole Grade 660). In atmospheres containing 1.7 to 21 ppM moisture and less than 50 ppM oxygen, the highest wear rate for this grade brush was 0.0189 in./hr. The Stackpole Grade 660 brush material is being used successfully on manipulator drive motors in the Argon Cell of the Fuel Cycle Facility. NSA

N67-27618*# General Electric Co., Schenectady, N. Y.
FLUID AMPLIFIER STATE-OF-THE-ART REPORT. VOLUME II-A: BIBLIOGRAPHY
M. J. Osborn Washington, NASA, May 1967 310 p refs
(Contract NAS8-5408)
(NASA-CR-734) CFSTI: $3.00 CSCL 13G

An annotated bibliography is presented on pure fluid (no-moving-part) devices and supporting technology. It cites 550 references of which 477 have been abstracted. A special effort was made to include references from outside of the United States. There has been a noticeable increase in foreign fluidic literature. Author

N67-27639*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: ACCEPTANCE TEST OF GULTON INDUSTRIES INCORPORATED 12 AND 20 AMPERE-HOUR ADHYDRODE CELLS
21 Jan. 1967 17 p
(NASA Order W-11252-B)
(NASA-CR-84421; QE/C-67-1) CSCL 10C

Performance evaluation tests were made on 12 and 20 ampere/hour secondary adhydrode spacecraft cells; observed were phenolphthalein leakage, capacity, cell short, immersion sealing, overcharge, internal resistance of adhydrode, and internal resistance of cell. Results showed that the ceramic seals of these cells were were phenolphthalein leakage, capacity, cell short, immersion sealing, overcharge, internal resistance of adhydrode, and internal resistance of cell. Results showed that the ceramic seals of these cells were satisfactory for all 42 cells tested. Cell capacities ranged from 14.82 to 16.50 ampere/hours for the 12 ampere/hour cells, and from 23.30 to 26.70 ampere/hours for the 20 ampere/hour cells, respectively. G.G.

N67-27666*# Rocketdyne, Canoga Park, Calif.
INVESTIGATION OF VARIABLES IN TURBINE EROSION, DROPLET FORMATION AND MATERIAL DAMAGE WITH STEAM Final Report, 30 Jun. 1965–31 Oct. 1966
R. Spies Nov. 1966 100 p refs
(Contract NAS7-391)
(NASA-CR-84499; R-6777) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Tests have been made with steam to determine the size, velocity, and origin of drops propagating through a typical stage of a space power turbine. Test conditions were chosen to simulate the passage of potassium vapor through the same turbine stage so that correlation with potassium-vapor experiments would be possible in the future. High-speed photographs have been obtained of the vapor flow to evaluate the erosion hazard to turbine blades. To evaluate material characteristics, turbine blades made of four different materials were run in the same wheel. Comparative weight-loss data and rate-of-loss data permit evaluation based on material properties. This evaluation is continuing. Tests with different quality, speed, and nozzle-to-rotor spacing are being conducted. Author

N67-27727# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF AN ADSORPTION CESIUM RESERVOIR Quarterly Technical Report
Sep. 1966 37 p
(Contract AT(30-1)-3642)
(NYO-3642-3; QTR-3) CFSTI: HC $3.00/MF $0.65

In developing an adsorption cesium reservoir for a thermionic converter, progress is reported on: (1) the testing of converters with external adsorption reservoirs; (2) the testing of converters with internal adsorption reservoirs; and (3) the modification of converters with internal adsorption reservoirs for life tests. Information is included on the characteristics of reservoir materials and structures. Thermal data obtained during the tests were useful in completing the design of a converter with an automatic, internal, cesium adsorption reservoir. The test apparatus is described, and test procedures are discussed. NSA

N67-27779# Thessaloniki Univ. (Greece).
MAGNETOSOLID MECHANIC GENERATOR [MAGNETO-STROPHON]
B. N. Spandos Sep. 1966 14 p
CFSTI: HC $3.00/MF $0.65

Movements produced by the action between artificial magnets and earth magnetism are discussed. Three magnets in linear array along north and south poles are depicted; the end magnets are fixed while the center magnet is free to rotate. An analytical calculation is presented of the aggregate magnetic forces, and equations are derived to investigate the analogy between the North and South Poles of the Earth. Transl. by R.U.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N67-26495# School of Aerospace Medicine, Brooks AFB, Tex.
THE EFFECT OF OXYGEN ON DOG PLASMA SULFHYDRYL GROUPS IN VITRO
Methodius J. Bartek Jan. 1967 12 p refs
(SAM-TR-67-5; AD-648127) CFSTI: HC $3.00/MF $0.65

A method is described in which biologic fluids are continuously exposed to a test atmosphere, and sampling is achieved without disruption of the atmosphere. Samples are withdrawn at intervals and analyzed for sulfhydryl content by amperometric titration with the rotating platinum electrode using $AgNO_3$ as the titrant. Inasmuch as this project was undertaken to study the effect of oxygen on sulfhydryl-containing enzymes in vitro, the system was first evaluated using dog plasma as the source of protein. The decrease in dog plasma sulfhydryl content over a 4-hour exposure was: 9.3% for nitrogen, 24.7% for air, and 39.2% for oxygen. Author (TAB)

N67-26503*# George Washington Univ., Washington, D. C. Biological Sciences Communication Project.
NASA CONTRACT LISTINGS OF PUBLICATIONS UNDER THE BEHAVIORAL BIOLOGY PROGRAM
L. A. Kulp, Frances Hong, and Shiela Rollins, comp. Feb. 1967 52 p refs
(Contract NSR-09-010-027)
(NASA-CR-84161) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The publications resulting from research supported, at least in part, by the Behavioral Biology Branch of the National Aeronautics and Space Administration's Bioscience Program Division are listed. A few publications, however, predate the establishment of this office but are included because they resulted from efforts which were subsequently subsumed under this program branch. Each project, indexed alphabetically according to principal investigator, reveals the published activity of each contractual endeavor. Author

N67-26561*# National Aeronautics and Space Administration, Washington, D. C.
GUARANTEEING RADIATION SAFETY DURING THE VOSKHOD AND VOSKHOD-2 FLIGHTS [OBESPECHENIYE RADIATSIONNOY BEZOPASNOSTI PRI POLETAKH KORABLEY "VOSKHOD" I "VOSKHOD-2"]
Yu. M. Volynkin, V. V. Antipov, B. I. Davydov, N. N. Dobrov, M. D. Nikitin et al Nov. 1966 6 p refs Transl. into ENGLISH of a Paper Presented at the 17th Intern. Astronautical Congr., Madrid, 9–15 Oct. 1966
(NASA-TT-F-10409) CFSTI: HC $3.00/MF $0.65 CSCL 06R

The radiation doses absorbed by the crews of Voskhod and Voskhod-2 spacecraft was discussed. The space walk by cosmonaut Leonov exposed him to a greater dose, requiring the use of a special protective space suit. The various sources of space radiation and the protection against them are examined. Some of the experiments performed by the cosmonauts concerning space radiation are also considered. Author

N67-26573*# National Aeronautics and Space Administration, Washington, D. C.
THE EFFECT OF PROLONGED ACCELERATION ON GAS EXCHANGE AND RESISTANCE OF RATS TO HYPOXIA [O VLIYANII PRODOLZHITEL'NYKH USKORENIY NA GAZOOBMEN I USTOYCHIVOST' K GIPOKSII U KRYS]
A. A. Gyurdzhian Nov. 1966 5 p refs Transl. into ENGLISH of a Paper Presented at the 17th Intern. Astronautical Congr., Madrid, 9–15 Oct. 1966
(NASA-TT-F-10406) CFSTI: $3.00 CSCL 06C

An investigation is made of the effect of prolonged acceleration on gas exchange and resistance of rats to hypoxia. An automatic gas-exchange investigating stand is described. It is found that in rats subjected to an increased force of gravity the gas exchange was lower than in control rats. The resistance of rats to "fatal hypoxia" proved to be higher than that of control rats. The resistance of test rats to "fatal acceleration", however, was lower than that of the control rats. Author

N67-26574*# National Aeronautics and Space Administration, Washington, D. C.
FUNDAMENTALS OF HUMAN BIOMECHANICS IN AN UNSUPPORTED SITUATION [OSNOVY BIOMEKHANIKI CHELOVEKA V BEZOPORNOM POLOZHENII]
V. I. Stephantsov and A. V. Yeremin Nov. 1966 6 p Transl. into ENGLISH of a Paper Presented at the 17th Intern. Astronautical Congr., Madrid, 9–15 Oct. 1966
(NASA-TT-F-10411) CFSTI: $3.00 CSCL 06S

The problem of orientation in space by man through his own efforts is discussed. Rotation of the body in weightlessness, the effect of moving one or both arms and the legs, and the most effective methods of rotating in a supportless situation are among the subjects treated. Rotation with the help of legs was found to be most effective. On the basis of the results presented the authors assert that after special training a man in a supportless situation will be able to orient himself quickly and accurately in any direction solely by his own muscular effort. Author

N67-26576*# National Aeronautics and Space Administration, Washington, D. C.
THE TRANSFORMATION OF HUMAN METABOLIC PRODUCTS AND PRODUCTS OF A BIOLOGICAL COMPLEX DURING THE RECIRCULATION OF SUBSTANCES IN SMALL, CLOSED SPACES [O TRANSFORMATSII PRODUKTOV ZHIZNEDEYATEL'NOSTI CHELOVEKA I BIOKOMPLEKSA PRI OSUSHCHESTVLENII KRUGOVOROTA VESHCHESTV V MALYKH ZAMKNUTYKH PROSTRANSTVAKH]
V. I. Yazdovskiy, A. L. Agre, B. G. Gusarov, Yu. Ye. Sinyak, S. V. Chizhov et al Nov. 1966 9 p Transl. into ENGLISH of a Paper Presented at the 17th Intern. Astronautical Congr., Madrid, 9–15 Oct. 1966
(NASA-TT-F-10405) CFSTI: HC $3.00/MF $0.65 CSCL 06S

A discussion is presented on the problems involved in creating life-support systems on the basis of recirculation of substances in closed spaces. The three stages identified are: (a) completely closed cycle, including regeneration of water, purification of the atmosphere, and providing man with food; (b) partially closed cycle, including regeneration of water and the atmosphere and obtaining food products of plant origin with the existence of an unreplenished supply of food products of animal origin; (c) open life-support system leased on supplies of food but including regeneration of water and atmosphere. Mineralization of solid and dehydrated waste products is discussed. Author

N67-26580*# Holman (John F.) and Co., Inc., Washington, D. C.
UTILIZATION OF AMINO ACIDS OF L-CONFIGURATION AND D-CONFIGURATION BY B. BREVIS CULTURES [UTILIZATSIYA AMINOKISLOT L- AND D-KONFIGURATSII KUL'TURAMI B. BREVIS]
A. S. Konikova and N. N. Dobbert Washington, NASA, Apr. 1967 11 p refs Transl. into ENGLISH from Biokhimiya (Moscow), v. 13, no. 2, 1948 p 115–123
(Contract NASw-1495)
(NASA-TT-F-10887) CFSTI: $3.00 CSCL 06A

Cultures of B. brevis were grown on media containing various amino acids as sources of nitrogen and carbon to determine the specificity of the utilization of these acids by this bacteria. It was found that growth occurred on media containing *l*-monoamino carbonic acids, *l*-diamino carbonic acids, *l*-proline, *l*-histidine, and glycine. Glucose added to these media stimulated growth. Growth absolutely did not occur on leucine, isoleucine, oxyproline, tryptophane, or tyrosine. Glucose did not alter this situation. The proteins of B. brevis were found to have a specific structure containing d-amino acids. Author

N67-26824*# National Aeronautics and Space Administration, Washington, D. C.
CERTAIN PROBLEMS RESULTING FROM EFFECTS OF ACCELERATION DURING SPACE FLIGHT (EFFECTS OF CUMULATION AND ADAPTATION) [NEKOTORYYE PROBLEMY DEYSTVIYA PEREGRUZOK V KOSMICHESKOM POLETE]
A. R. Kotovskaya Nov. 1966 19 p refs Transl. into ENGLISH from Russian Presented at the 17th Intern. Astronautical Cong., Madrid, 9–15 Oct. 1966
(NASA-TT-F-10412) CFSTI: HC $3.00/MF $0.65 CSCL 06S

An investigation was performed in order to make a comprehensive study of clinico-physiological, biochemical, hematological, roentgenological, and pathomorphological changes occurring in the organism of animals subjected to one-time or repeated effects of acceleration. The tests conducted used 50 dogs and 13 monkeys.

A maximum tolerable duration to an acceleration of 12 g units was established for the monkeys. A correlation of changes in the roentgenological, clinical, and pathomorphological pictures was established. Repeated exposure to acceleration in the organism of an animal may cause various adaptive and cumulative damaging effects. Author

N67-26632*# National Aeronautics and Space Administration, Washington, D. C.
PROBLEMS IN PHARMACOLOGY IN SPACE MEDICINE [PROBLEMA FARMAKOLOGII V KOSMICHESKOY MEDITSINE]
V. Ye. Belay, P. V. Vasil'yev, and G. D. Glod Nov. 1966 16 p refs Transl. into ENGLISH from Russian Presented at the 17th Intern. Astronautical Cong., Madrid, 9–15 Oct. 1966
(NASA-TT-F-10410) CFSTI: HC $3.00/MF $0.65 CSCL 06O

The efficient use of drugs in the preparation for and medical support of distant space flights is discussed. Some trends in the possible use of drugs during space flight already detectable include: (1) stimulation of natural compensatory-adaptive mechanisms of organisms to produce increased resistance to extreme factors; and (2) prevention of infectious, neuropsychic, and somatic diseases and radiation damage; (3) treatment of current diseases; and improving work capability (relieving fatigue and neuroemotional tension). Many drugs in conventional use and some specific drugs for space applications are considered in detail. Author

N67-26714# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
PROCEEDINGS OF THE 2nd ANNUAL CONFERENCE ON ATMOSPHERIC CONTAMINATION IN CONFINED SPACES, 4 AND 5 MAY 1966
Dec. 1966 338 p refs
(AMRL-TR-66-120; AD-646512) CFSTI: HC $3.00/MF $0.65

Conference papers are presented covering such major technical areas as toxicology of space cabin materials, comparative toxicology and pathology of oxygen, and the effects of oxygen on contaminant toxicity. For individual titles, see N67-26715 through N67-26735.

N67-26715# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
PARTS AND MATERIALS DATA RETRIEVAL PROGRAM RELATIVE TO MATERIALS SELECTION IN TOXICOLOGY
Elliott S. Harris *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 9–13 (See N67-26714 14-04)

Described is a data retrieval system that was established to centralize the data obtained by manufacturers and test organizations; to reduce redundancy of testing effort to a minimum; and to provide a basis for toxicological testing. Although this effort was initiated as a separate entity, it has been incorporated into an Apollo parts and materials master file on the premise that the nonmetallic materials used in the Apollo or LEM spacecraft will not differ too greatly from future generation spacecraft. The master file provides a program of parts and materials used in the Apollo and LEM spacecrafts. The computer will printout the nonmetallic materials on a selective basis and provide information which not only allows the identification of the material in question, but also the manufacturer of the material, its specifications, the contractor who used the material, the spacecraft on which the material is used, and the location within the spacecraft. Provisions are also made for the inclusion and retrieval of off-gassing rates, total quantities of gases released under specific test conditions, and the compounds which are identified. Studies designed to analyze closed environments for the purpose of identifying man's contribution to the microcontaminant picture, are also cited. The information retrieved from this data system will be used to establish areas of investigation for long term toxicity in closed environments. S.C.W.

N67-26720# Aerojet-General Corp., Dayton, Ohio.
OXYGEN TOXICITY AT NEAR-AMBIENT PRESSURES
James D. MacEwen and Charles C. Haun *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 65–72 refs (See N67-26714 14-04)
(Contract AF 33(657)-11305)

Two experiments were conducted to determine if the observed mortality response of albino rats of the Wistar strain and Sprague–Dawley rats of the SPF strain was the result of exposure to environments of increased partial pressure of oxygen or decreased total pressure. The first experiment was carried out at near atmospheric pressure in the presence of 100% oxygen. The Sprague–Dawley SPF strain rats and both young and old Wistar strain rats were used. The second experiment was conducted at near atmospheric pressure with an enrichment of oxygen to 260 mm Hg partial pressure. Primary objectives of these experiments were to determine whether the observed mortality response was a strain specific effect, and whether age influenced the degree of susceptibility to the environmental conditions. The experiments demonstrated a decreasing oxygen toxicity response with decreasing total pressure. Also demonstrated was a sex difference in toxic response between male and female rats, and a difference in response between young and older animals. The mortality rate of Wistar strain rats exposed to a 5 psia–100% oxygen environment was definitely ascribed to a strain-specific pressure sensitivity. In addition, a definite difference in toxic response was demonstrated between experiments conducted in dynamic flow and recirculating chamber systems. It appears that some metabolic waste materials or their oxidation products may be accumulated in a recirculating system which are capable of enhancing oxygen toxicity. S.C.W.

N67-26721# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
PATHOLOGICAL EVALUATION OF OXYGEN TOXICITY AT NEAR-AMBIENT PRESSURES
Farrel R. Robinson and David T. Harper, Jr. *In its* Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 73–79 refs (See N67-26714 14-04)

Presented is a pathological evaluation of the effect of species, age, strain, and individual susceptibility on the type and severity of lesion induced by continuous exposure to high concentrations of oxygen at pressures of 600 to 760 mm Hg for periods up to 16 days in the Thomas Domes. Examined were rats, mice, dogs, and monkeys. It is shown that the type of pulmonary lesion induced by high concentrations of oxygen at pressures of 600 to 760 mm Hg depends upon the species, age, strain, and individual susceptibility of the experimental animal. Monkeys are apparently more resistant to acute oxygen toxicity than rats, but do develop an extreme subacute pulmonary proliferative response. Younger animals seem to have more resistance to high concentrations of oxygen than older animals. Pronounced differences in mortality, and consequently pulmonary lesions, indicate that a conventionally raised Harlan Sprague–Dawley strain of rats is more susceptible than either a Wistar strain or a specific pathogen free Carworth Sprague–Dawley strain. Differences in individual susceptibility of a supposedly homogeneous group of either monkeys or rats are evident; some animals die with acute lesions and others accommodate and later develop subacute lesions. It is therefore concluded that the pathologic response of the lung to high concentrations of oxygen is quite variable with many biological influences contributing to the ultimate pathologic picture. S.C.W.

N67-26722# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson, AFB, Ohio.
TOXICITY STUDIES ON ANIMALS EXPOSED CONTINUOUSLY TO A 5 PSIA 100% OXYGEN ENVIRONMENT FOR PERIODS UP TO 235 DAYS
Kenneth C. Back *In its* Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 80–87 (See N67-26714 14-04)

Reported are clinical laboratory parameters obtained from toxicity studies of the effects of 100% oxygen at 5 psia on animals exposed continuously for periods up to 235 days. Presented are data for male mice, male rats (Sprague–Dawley), female and male beagle dogs, and male and female *Macaca mulatta* monkeys. All experimental animals were weighed and clinical baseline values were determined at least four times during the month before exposure. Tabulated are hematologic and serum chemistry clinical parameters for dogs and monkeys, operating parameters for the dome used in tests; mortality data; and hematologic data on all animals studied. Other studies were performed to obtain cellular enzyme data. S.C.W.

N67-26723# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

PATHOLOGY OF ANIMALS EXPOSED TO A PURE OXYGEN ATMOSPHERE AT REDUCED PRESSURE FOR PROLONGED PERIODS

David T. Harper, Jr. and Farrel R. Robinson *In its* Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 88–102 refs (See N67-26714 14-04)

Gross and histological pathological changes observed in purebred beagle dogs, *Macaca mulatta* monkeys, Wistar rats, and male Harlan mice, after prolonged exposure to a pure oxygen atmosphere at reduced pressures; are reported. Data on mortality and the incidence of infectious disease are also reported. S.C.W.

N67-26724# Laboratory for Experimental Biology, St. Louis, Mo.

PATHOLOGY OF ANIMALS EXPOSED FOR 235 DAYS TO A 5 PSIA 100% OXYGEN ATMOSPHERE

O. E. Hagebusch *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 103–107 (See N67-26714 14-04)

Gross and histological pathological changes observed in rats, mice, monkeys, and dogs, after exposure for 235 days to a 5 psia 100% oxygen atmosphere; are reported. On the basis of experiments on this small group of animals, it is suggested that 258 mm Hg 100% oxygen for 230 days may be toxic for the dog. There was no evidence that this concentration was toxic for mice or monkeys under the same experimental conditions. To confirm these findings, dog and rat microscopic sections were reviewed by eight pathologists after the original findings had been recorded. Except for minor variations in degree of pathology thought to be present and some disagreement on the presence or absence of minor changes, all diagnoses were in agreement. It is the considered opinion that when dogs are exposed to 258 mm Hg 100% oxygen for 230 days, pathological changes are present in the lungs. It is thought that subtle changes may be present in rats at this same exposure; however, further studies are necessary before this can definitely be determined. Acute pulmonary pathology which is considered to be related to experimental conditions consists of various combinations of hemorrhage, edema, congestion, bronchiolitis, mucous plugs, edema and inflammation about vessels, thickening and proliferation of alveolar walls, interstitial pneumonia, atelectasis, and bronchial pneumonia. The temporal relationships of these changes are discussed. S.C.W.

N67-26725# Zurich Univ. (Switzerland).

ELECTRON MICROSCOPIC INVESTIGATIONS OF OXYGEN EFFECTS ON LUNG TISSUE

Gonzague S. Kistler, Ewald R. Weibel, and Peter R. B. Caldwell (AMRL Wright-Patterson, Air Force Base, Ohio) *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 108–161 refs (See N67-26714 14-04)
(Contract AF 61(052)-784)

Presented are results of electron microscopic and morphometric studies of rat lungs exposed to 98.5% oxygen at atmospheric pressure, and 97% oxygen at 258 Torr. The purpose of these studies was to establish the time-sequence of changes occurring in the lung as a result of continued breathing of pure oxygen at atmospheric pressure, and to elucidate the effects of breathing essentially pure oxygen at 5 psia for up to two weeks. The primary site of damage caused by pure oxygen breathing at 765 Torr appeared to be in the endothelial cells of the pulmonary capillaries with resultant movement of fluid into the interstitial and alveolar spaces. After 72 hours of oxygen exposure, the alveolo-capillary tissue barrier had doubled in thickness, the capillary bed was reduced in volume by about one half, and a profuse exudate containing numerous cells had covered about 65% of the alveolar space. These factors combined to progressively reduce the estimated diffusing capacity of the air–blood barrier to about 9% of its normal value. It appears that the basic toxic effect of oxygen must be initiated rather early, that is towards the end of the first day of exposure, since all the observed effects must be secondary to some still unknown disturbance at the subcellular or even molecular level. The morphometric electron microscope study of lungs exposed to 97% oxygen at 5 psia (258 torr) revealed a reduction in specific gas exchange surface by about 27% after two weeks, with a concurrent decrease in capillary volume and surface. This change is interpreted as an oxygen effect, but cannot be called oxygen toxicity. It is rather regarded as an adaptive process of the growing organism to increased availability of oxygen in the breathing medium. S.C.W.

N67-26726# Mount Sinai Medical and Graduate Schools, New York.

ELECTRON MICROSCOPIC INVESTIGATIONS OF OXYGEN EFFECTS ON LIVER TISSUE

Fenton Schaffner *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 162–169 refs (See N67-26714 14-04)

Presented are results of electron microscopic studies of the livers of rats, dogs, and monkeys exposed to pure oxygen at pressures from 1/3 to 3 atmospheres, from three hours to eight months. The purposes of these studies were to determine the ultrastructural changes which occur in a metabolically active organ during hyperoxia, to gain some insight into the nature of oxygen toxicity on a cellular level, and to see whether adaptation to the new atmosphere develops. In rats, it was observed that the higher the atmospheric pressure the more rapidly hepatocellular alterations appeared. Sprague–Dawley rats showed more severe changes than Wistar rats but no differences could be found between males and females. Of the three species studied, the least changes in glycogen were present in dogs. Mitochondrial alterations were present and after 8 months at 258 mm Hg this was greatest in this species. The most striking finding was the large number of pigment-containing lysosomes and autophagic vacuoles. The glycogen depletion in monkeys was the same as in the rats. The mitochondrial changes were less striking and did not follow as clear a time sequence as in the rats. The livers of rats, dogs, and monkeys showed signs of mitochondrial alteration primarily; however, adaptation to the new atmosphere occurred although this process appears to be a continual one. Species differences were quantitative rather than qualitative. The major unanswered question in these studies was whether the livers of animals so exposed are more sensitive than normals to the action of other toxins. S.C.W.

N67-26727# Mount Sinai Hospital, New York.

ELECTRON MICROSCOPIC INVESTIGATIONS OF OXYGEN EFFECTS ON KIDNEY TISSUE

Willy Mautner *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 170–177 refs (See N67-26714 14-04)
(Contract AF 33(615)-1849)

Reported are results of electron microscopic studies of the kidneys of Sprague–Dawley rats, monkeys, and dogs exposed to hyperoxic environments. The purpose of these studies was to

determine whether changes in the kidney renal cortical tissues after short term exposures were reversible after long term exposures. Changes in the renal cortex were confined to the cells of the proximal convoluted tubules. Distal tubules and collecting ducts were normal in both control and experimental groups. Two types of changes were found: mitochondrial alterations (in all species studied), and an increase in number of a small cell organelle in dogs and monkeys. These changes tended to revert to normal on prolonged exposure. S.C.W.

N67-26728# IIT Research Inst., Chicago, Ill.
CELLULAR BIOCHEMISTRY OF OXYGEN TOXICITY
Willis H. Riesen *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 178–199 refs (See N67-26714 14-04)

Reported are studies focusing on the biochemical aspects of oxygen toxicity at a cellular and a mitochondrial level. Presented are results of biochemical and morphological studies of rats exposed to atmospheres of pure oxygen at 760 mm Hg in the Felig–Lee environmental chamber, or in the same atmosphere at 750 to 760 mm Hg in the Thomas Dome. Biochemical studies included analyses of liver mitochondria, lung mitochondria, whole liver, whole lung, and arterial blood. In addition to changes in biochemical indices, changes in animal weight during exposure to oxygen or air were observed. The objective of the experimental exposures of animals to 1/3 atm of pure oxygen was to determine whether biochemical changes could be detected in animals exposed to atmospheres simulating those of manned space flight. Data on rats exposed in the Thomas Dome for as long as 236 days; dogs exposed to oxygen at 258 mm Hg in the Thomas Dome for 236 days; and monkeys exposed to oxygen at 258 mm Hg in the Thomas Dome for 236 days with a 40-day air recovery; are presented. Areas requiring further study such as the protective effect of lactate; the effects of oxygen exposure upon specific enzyme systems; and the development of instrumentation of greater sensitivity and precision; are cited. S.C.W.

N67-26729# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson, AFB, Ohio.
HEMATOLOGIC EFFECTS OF INCREASED OXYGEN TENSIONS
Harold P. Kaplan *In its* Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 220–222 refs (See N67-26714 14-04)

Presented is a review of historical and recent studies on the hematologic effects of increased oxygen tensions on humans and laboratory animals. It is concluded that although the bulk of data arising from both animal and human exposures to increased oxygen tensions is both incomplete and inconsistent, the analysis of available information suggests the following: (1) The erythrocyte is sensitive to small variations in oxygen tension in the blood and the foci of sensitivity to increased oxygen tension are in the cell membrane where unsaturated fatty acids are subject to peroxidation, and intracellularly, where the balance between aerobic and anaerobic metabolic pathways is altered and the activities and integrity of various enzyme systems in both pathways are possibly affected. (2) Hematopoiesis, specifically erythropoiesis, is probably depressed by increased oxygen tensions just as it is stimulated by decreased oxygen tensions. (3) When exposed continually to a space capsule environment of pure oxygen at 5 psi, the normal individual probably experiences a decrease in circulating red cell mass secondary to gradual hemolysis arising from the above cited mechanisms and occurring only after his antioxidant defenses are overcome. (4) When exposed to the markedly increased oxygen tensions of a hyperbaric chamber, an individual probably undergoes the same changes but at a relatively accelerated rate. (5) Leukocytosis, seen in most of the exposures cited, is probably a nonspecific stress response. S.C.W.

N67-26730# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
PSYCHOPHARMACOLOGICAL EVALUATION OF PRIMATES EXPOSED TO 5 PSIA 100% OXYGEN ATMOSPHERE
Thomas L. Wolfle *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 223–235 refs (See N67-26714 14-04)

In view of the need for more information on performance changes which might be associated with a single gas environment, at altitude, over a significant period of time; experiments were conducted on 12 mature subhuman primates to evaluate the effects on performance of breathing 100% oxygen at 5 psia for 90 days. Individual work chambers were specifically designed to fit into the Thomas Dome hypobaric chamber. Each work chamber provided adequate quarters for a small primate for an extended time period. In addition, each chamber was fitted with a psychomotor work panel and an automatic system for water ad libitum. The schedule was 15 minutes in duration, followed by a 45-minute rest period and consisted of the following three integrated tasks: (1) dual continuance avoidance; (2) auditory response time; and (3) visual response time. On the basis of experimental findings it is concluded that: (1) Subhuman primates do not exhibit performance changes of any serious consequence when exposed to 100% oxygen at 5 psia for three months. (2) Performance decrements which were detected were generally closely associated with loss of environmental control or apparatus malfunctioning. (3) Measures of auditory functioning can be made only when noise within the experimental situation is sufficiently low or masked to preclude interference with the signal to the subject. (4) Proper controls over the environment and experimental apparatus must be planned for and accomplished if the reliability and validity of performance measures is to be achieved. S.C.W.

N67-26731# Aerojet-General Corp., Dayton, Ohio.
COMPARATIVE TOXICITY STUDIES ON ANIMALS EXPOSED CONTINUOUSLY FOR PERIODS UP TO 90 DAYS TO NO_2, O_3, AND CCl_4 IN AMBIENT AIR VS. 5 PSIA 100% OXYGEN ATMOSPHERE
James D. MacEwen and Robert P. Geckler *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 238–259 refs (See N67-26714 14-04)

A study designed to evaluate the response of animals to toxic materials administered under conditions of reduced pressure and varying partial pressures of oxygen, is reported. Emphasized is the applicability of data gathered under these conditions to manned space flight programs, and their usefulness in the definition of contaminant tolerance levels and acceptable atmospheres for space cabins enduring prolonged flights. Beagle dogs, rhesus monkeys, mice, rats, and in one case, guinea pigs, were subjected to continuous exposure of threshold limit values (TLV) concentrations of nitrogen dioxide, ozone, and carbon tetrachloride for periods of 90 days in both 100% oxygen at 260 mm Hg and air at 720 to 740 mm Hg pressure. The following three factors were focused on in these experiments: oxygen atmosphere, reduced pressure, and continuous exposure. A review of two weeks experiments is also included. On the basis of data obtained, evidence is reasonably conclusive that, for the materials and conditions used in the experiments, the TLV for space cabin conditions may not be radically different from industrial TLV. Threshold limit values have classically included a large and sometime unknown safety factor. In view of the fact that some differences were found, there is indication that perhaps the safety factors of the TLV for the three materials studied were about to be exceeded. It is concluded that, it does not appear clear that the TLV for space applications may not be radically different from industrial TLV if only the factors of continuous dosage, reduced pressure, and pure oxygen atmosphere are considered. S.C.W.

N67-26732# Laboratory for Experimental Biology, St. Louis, Mo.
PATHOLOGICAL EFFECTS OF EXPOSURE TO PULMONARY IRRITANTS AT AMBIENT AIR VS. 5 PSIA 100% OXYGEN ATMOSPHERE FOR PERIODS UP TO 90 DAYS
R. L. Patrick *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 260–264 (See N67-26714 14-04)

Reported is a study designed to compare the toxic effects of contaminants under conditions of 5 psia (pounds per square inch, absolute) and 100% oxygen and normal atmospheric conditions. Mortality and pathologic alterations were evaluated in monkeys, rats, and dogs exposed continuously to various concentrations of nitrogen dioxide and ozone for 14 days. All three species exposed to two concentrations of NO_2 and ozone showed greater mortality at ambient conditions than at altitude. Animals dying early showed changes under both conditions. Survivors of each group showed similar changes except in isolated instances. Alveolar hemorrhage and edema were the most prominent changes associated with early death. It appears that 5 psia, 100% oxygen offered some degree of protection against alveolar hemorrhage and edema. In some groups inflammatory changes were more marked under altitude conditions; however, this is thought to reflect the longer survival of this group. S.C.W.

N67-26733# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson, AFB, Ohio.
COMPARATIVE PATHOLOGY OF ANIMALS EXPOSED TO CARBON TETRACHLORIDE AT AMBIENT AIR VS. 5 PSI 100% OXYGEN ATMOSPHERE
David T. Harper, Jr. and Farrel R. Robinson *In its* Proc. of the 2d Ann. Conf. on Atmospheric Contamination of Confined Spaces Dec. 1966 p 265–278 refs (See N67-26714 14-04)

Carbon tetrachloride was used as a contaminant in a series of 2 week animal exposures in atmospheres of 100% oxygen at 258 mm Hg (5 psia) and air at 700 mm Hg. Presented are results of comparative pathological studies of young male and female beagle dogs, *Macaca mulatta* monkeys, Wistar and SPF Sprague–Dawley rats, and male Harlan ICR mice. The implications of these studies are twofold. First, the effect of alterations of atmospheric composition on the toxic properties of this specific systemic agent may well be applicable to other possible contaminants in confined systems. Second, recent biochemical findings pertaining to carbon tetrachloride toxicity suggest that an atmosphere containing a high partial pressure of oxygen would exert a synergistic effect with this agent. In view of the fact that all species had high levels of sporadic, enzootic, and unrelated pathology, changes in the liver in each species and deaths among exposed mice were used as the basis for evaluating the effects of CCl_4 at altitude and ambient conditions. The most telling argument for an increased toxic effect of CCl_4 under altitude conditions was the great difference in mortality among mice exposed at the highest concentrations. All of the classic histologic signs of CCl_4 poisoning of the liver were observed. It is surmised that it is very likely that the basic biochemical mechanisms of both oxygen and CCl_4 toxicity are highly similar. The superimposition of the one stress on the other therefore would be expected to have an additive or synergistic effect, which is what was observed in these studies. S.C.W.

N67-26735# Aerojet-General Corp., Dayton, Ohio.
EFFECT OF A MIXED GAS ATMOSPHERE AT 5 PSIA ON THE TOXICITY OF NO_2 AND O_3 IN ANIMALS
James D. MacEwen and James M. McNerney *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 290–314 refs (See N67-26714 14-04)

An experimental protocol, similar to that used previously for two week continuous exposures to the intermediate chamber concentrations of NO_2 and O_3 (38.8 and 8.0 mg/M^3, respectively), was designed to study the effect of a mixed gas environment on the toxicity of these gases. Nitrogen, rather than helium, was used as the inert part of the gas mixture. Studied were the effects of the mixed gaseous atmosphere on rats, dogs, and monkeys. The 14-day continuous exposure of laboratory animals to an ozone chamber concentration of 8.0 mg/M^3 in the mixed gas environment at 5 psia resulted in a mortality that was intermediate to previously reported studies. To verify the protective effect of oxygen against O_3 toxicity, an additional experiment was conducted at near ambient pressure air enriched with oxygen to produce a pO_2 of 260 mm Hg. Only dogs and monkeys were used. The mortality response was reduced to zero and no clinical symptoms of ozone toxicity were observed in the exposed animals. It is concluded that there is a reduction in toxicity of pulmonary irritants in a 5 psia 100% oxygen environment and that this protection is apparently the result of increased oxygen partial pressure. In ozone, the protective action of oxygen is clear cut and extends into the ambient pressure range. This may indicate the potential efficacy of oxygen therapy in ozone exposures. The evidence for the protective action of oxygen against NO_2 toxicity was not definite. S.C.W.

N67-26737# Naval Training Device Center, Port Washington, N. Y.
EFFECTS OF SIGNAL PATTERNING UPON VIGILANCE PERFORMANCE AND PHYSIOLOGICAL RESPONSES
John L. Andreassi and M. Stephen Huntley, Jr. Jan. 1967 36 p refs
(NAVTRADEVCEN-IH-62; AD-648948) CFSTI: HC $3.00/MF $0.65

The purpose of the investigation was twofold: (1) to determine the effect of signal patterning upon physiological responses and time to detect signals; (2) to study performance of subjects (Ss), with and without patterning, under conditions in which they were either informed or uninformed about the signal patterning. Vigilance performance and physiological responses with variable interval (VI) and fixed interval (FI) signal patterns were studied in four groups of Ss. Three of the four groups were required to make responses (telegraph key presses) in order to detect signals. Reaction time (RT) was used as the performance measure while heart rate (HR), palmar skin conductance (PSC) and galvanic skin responses (GSRs) were the physiological measures. Each S was tested in two separate one hour sessions on each of two days. The results indicated that there was a tendency for RTs to be faster under the FI schedule of signals than with the VI. The HR and PSC measures showed higher variability with the VI schedule while GSRs were more variable under the FI schedule. Faster RTs tended to be related to higher levels of HR, PSC and GSRs. It was suggested that: (1) faster RTs under the FI schedule reflected greater learning of the regular signal pattern; (2) faster RTs with higher degrees of physiological activation were due to greater numbers of sensory impulses which traveled cortically and had effect of improving alertness and readiness to respond. Several implications of these results for training are discussed. Author (TAB)

N67-26750# Stanford Univ., Calif. Biophysics Program.
INITIAL CONDITIONS, PHYSICAL LAWS, AND THE ORIGIN OF LIFE
H. H. Pattee Dec. 1966 15 p refs Presented at the Am. Phys. Soc. Winter Meeting, Stanford, Calif., Dec. 1966
(Contract Nonr-225(90); Grant NSF GB-4121)
(BL-186; AD-648738) CFSTI: HC $3.00/MF $0.65

The paper explores the meaning of the origin of life using the language of physics. It attempts to arrive at a physical theory of the origin of life and discusses some possible experimental approaches to see if the theory can be tested. Author (TAB)

N67-26781# California Univ., Berkeley. Lawrence Radiation Lab.
BIOLOGY AND MEDICINE Semiannual Report
John H. Lawrence, ed. 1966 157 p refs
(Contract W-7405-ENG-48)
(UCRL-16898) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. ENDOGENOUS PRODUCTION OF ^{14}CO: AN *IN VIVO* TECHNIQUE FOR THE STUDY OF HEME CATABOLISM S. A. Landaw and H. S. Winchell p 1–10 refs (See N67-26762 14-04)

2. A SIGNIFICANT DIFFERENCE IN MAMMALIAN-CELL POLYPOIDY INDUCTION BETWEEN PLATEAU AND "STAR" REGIONS OF A NEGATIVE PION BEAM W. D. Loughman, H. S. Winchell, M. R. Raju, and J. H. Lawrence p 11–13 refs (See N67-26763 14-04)

3. BIOLOGICAL SPECIALIZATION IN MEGAKARYOCYTES AND PLATELETS J.-M. Paulus p 14–21 refs (See N67-26764 14-04)

4. THE EFFECT OF ERYTHROPOIETIN ON THE GROWTH AND DEVELOPMENT OF SPLEEN COLONY-FORMING CELLS J. C. Schooley p 22–41 refs (See N67-26765 14-04)

5. INFLUENCE OF SEVERE HYPOXIA ON HUMAN ERYTHROPOIETIN W. E. Siri p 42–52 refs (See N67-26766 14-04)

6. STUDIES ON THE THYMUS AND THE RECIRCULATING LYMPHOCYTE POOL J. C. Schooley and M. M. Shrewsbury p 53–63 refs (See N67-26767 14-04)

7. SERUM-LIPOPROTEIN DISTRIBUTION AND PROTEIN ANALYSIS BY REFRACTOMETRY F. T. Lindgren, N. K. Freeman, R. D. Wills, A. M. Ewing, and L. C. Jensen p 64–71 refs (See N67-26768 14-04)

8. STUDIES ON DEFICIENT MAMMALIAN CELLS ISOLATED FROM X-IRRADIATION CULTURES P. W. Todd p 72–81 refs (See N67-26769 14-04)

9. FLUCTUATIONS OF ENERGY LOSS BY HEAVY CHARGED PARTICLES IN THIN ABSORBERS H. D. Maccabee, M. R. Raju, and C. A. Tobias p 82–86 refs (See N67-26770 14-24)

10. SECONDARY-ELECTRON DISTRIBUTION FOR HEAVY IONS N. Oda and J. T. Lyman p 87–96 refs (See N67-26771 14-24)

11. THE INTERPRETATION OF MICROBIAL INACTIVATION AND RECOVERY PHENOMENA R. H. Haynes p 97–116 refs (See N67-26772 14-04)

12. INACTIVATION OF PHAGE α BY SINGLE-STRAND BREAKAGE D. Freifelder p 117–122 refs (See N67-26773 14-04)

13. REPLICATION OF DNA DURING F'LAC TRANSFER D. Freifelder p 123–127 refs (See N67-26774 14-04)

14. PLEIOTROPY AND POLYMORPHISM J. L. King p 128–129 refs (See N67-26775 14-04)

15. INCREASE IN PLASMA GROWTH-HORMONE LEVEL IN THE MONKEY FOLLOWING THE ADMINISTRATION OF SHEEP HYPOTHALMIC EXTRACTS J. F. Garcia and I. I. Geschwind p 130–136 refs (See N67-26776 14-04)

N67-26762# California Univ., Berkeley. Lawrence Radiation Lab.

ENDOGENOUS PRODUCTION OF ^{14}CO: AN *IN VIVO* TECHNIQUE FOR THE STUDY OF HEME CATOBOLISM

Stephen A. Landaw and Saul Winchell *In its* Biol. and Med. 1966 p 1–10 refs (See N67-26761 14-04)

A method is presented for the separation, detection, and quantitation of endogenously produced carbon-14-labeled carbon monoxide in the rat, following injection of glycine-2-^{14}C. In this method, respiratory $^{14}CO_2$, the only significant breath contaminant, is removed with a sodalime absorber. The remaining breath activity, due primarily, if not entirely, to ^{14}CO, is oxidized to $^{14}CO_2$ by Hopcalite, absorbed in an ethanolamine-containing solution, and counted by liquid scintillation. Standard ^{14}CO and $^{14}CO_2$ gases, as well as animal experimentation, confirm this method's ability to measure ^{14}CO and $^{14}CO_2$ production rates simultaneously, following a single injection of labelled glycine. Examples are given to show that this continuous, in vivo, and easily performed method can give important information concerning heme catabolism. The technique should provide a unique source of information in the study of disease processes characterized by abnormal heme catabolism in man and other animals. Author (NSA)

N67-26763# California Univ., Berkeley. Lawrence Radiation Lab.

A SIGNIFICANT DIFFERENCE IN MAMMALIAN-CELL POLYPLOIDY INDUCTION BETWEEN PLATEAU AND "STAR" REGIONS OF A NEGATIVE PION BEAM

William D. Loughman, H. Saul Winchell, Mudundi R. Raju, and John H. Lawrence *In its* Biol. and Med. 1966 p 11–13 refs (See N67-26761 14-04)

A preliminary report showed that plateau and star (or peak) regions of negative pion beams differ in their capacity to induce polyploidy and other effects on mammalian cells in vivo. Results are reported from further work in which a statistically significant difference between the effects of the two beam regions was demonstrated. Mice with the A-2 lymphoma as an ascites tumor were irradiated in a negative pion beam from the 184-inch cyclotron. Mice in the plateau portion of the beam (about 60% pions) received an average dose of about 230 rads. Mice in the peak region of the beam (30 to 40% pions) received about 350 rads. On the third and fourth days following irradiation, ascites cells were removed from the mice and prepared for chromosome examination, and 4,000 metaphase cells from each mouse were scored as essentially diploid or as polyploid. In each case the incidence of polyploidy among irradiated cells was increased over control values. Significantly higher values were seen in cells irradiated in the beam's peak region than in cells irradiated in the plateau region. NSA

N67-26764# California Univ., Berkeley. Lawrence Radiation Lab.

BIOLOGICAL SPECIALIZATION IN MEGAKARYOCYTES AND PLATELETS

Jean-Michel Paulus *In its* Biol. and Med. 1966 p 14–21 refs (See N67-26761 14-04)

Data from recent studies on the biological specification in megakaryocytes and blood platelets are summarized. Data are included on the metabolic behavior of circulating platelets. NSA

N67-26765# California Univ., Berkeley. Lawrence Radiation Lab.

THE EFFECT OF ERYTHROPOIETIN ON THE GROWTH AND DEVELOPMENT OF SPLEEN COLONY-FORMING CELLS

John C. Schooley *In its* Biol. and Med. 1966 p 22–41 refs (See N67-26761 14-04)

The development of erythroid colonies in the spleens of lethally γ irradiated mice following bone marrow transplantation was suppressed by the production of polycythemia or the injection of antibody against erythropoietin into the host mice. The injection of exogenous erythropoietin into nonpolycythemic animals did not increase the number of spleen colonies produced by a bone-marrow transplant. The injection of exogenous erythropoietin into polycythemic host mice in some experiments did not significantly alter the number of colonies produced by a bone-marrow transplant, whereas in other experiments a marked increase in the number of spleen colonies occurred. The discrepancy between theee experiments is discussed. The overall doubling time of colony-forming cells in the spleens of polycythemic mice was not altered by the injection of exogenous erythropoietin during the first 10 days after bone marrow transplantation. Some evidence is presented suggesting that the doubling time of colony-forming cells in polycythemic mice receiving erythropoietin was maintained equal to that observed in polycythemic mice not receiving erythropoietin by some change in the proliferation of colony-forming cells. Arguments are presented suggesting that erythropoietin does not act on the colony-forming cell directly, but upon some erythropoietin-sensitive cell derived from the colony-forming cell. Author (NSA)

N67-26766# California Univ., Berkeley. Lawrence Radiation Lab.

INFLUENCE OF SEVERE HYPOXIA ON HUMAN ERYTHROPOIETIN

William E. Siri *In its* Biol. and Med. 1966 p 42–52 refs (See N67-26761 14-04)

The total volume of red blood cells in the healthy person is controlled by the production of red cells whose rate, according to prevailing evidence, is mediated by erythropoietin. Whether or not primary control of erythropoiesis normally is vested in blood oxygen tension is not certain. It is clear, however, that low oxygen tension stimulates erythropoiesis to maintain a compensatory increase in red-cell volume that is related, in an ill-defined way, to degree of hypoxia. The influence of hypoxia on the regulation of red-cell volume was investigated in human subjects exposed to oxygen partial pressures ranging from 160 mm Hg (sea level) to 89 mm Hg (21,500 ft). Plasma-iron turnover, blood volume, and the ordinary hematological quantities were measured in Andean residents of 12,500 and 17,000 ft, and in climbers at sea level, at 17,800 ft, and at 21,500 ft, during an ascent of Mt. Everest. NSA

N67-26767# California Univ., Berkeley. Lawrence Radiation Lab.
STUDIES ON THE THYMUS AND THE RECIRCULATING LYMPHOCYTE POOL
John C. Schooley and Marvin M. Shrewsbury *In its* Biol. and Med. 1966 p 53–63 refs (See N67-26761 14-04)

The temporal relationships between thymectomy and the first indication of a depression in thoracic duct lymphocyte outputs was studied in rats. The effects of transplantation of thymic tissue on the thoracic duct lymphocyte output and the effect of altering the total recirculating lymphocyte pool, utilizing the technique of parabiosis, were also studied. NSA

N67-26768# California Univ., Berkeley. Lawrence Radiation Lab.
SERUM-LIPOPROTEIN DISTRIBUTION AND PROTEIN ANALYSIS BY REFRACTOMETRY
Frank T. Lindgren, Norman K. Freeman, Robert D. Wills, Alicia M. Ewing, and Lin C. Jensen *In its* Biol. and Med. 1966 p 64–71 refs (See N67-26761 14-04)

The use of refractometry for measurement of proteins in blood serum is discussed, with emphasis on the influence of lipoproteins on the accuracy of measurements of total proteins. A procedure is described for converting the measured refractive increment of each lipoprotein class to the appropriate value it would have in a serum background environment. Results are reported from measurements of mean values and standard deviations in serum proteins in nonfasting normal males and females using refractometry data or calculations by other formulae. Lipoproteins were isolated and measured either by refractometry or ultracentrifuge methods with corrections made by means of a computer program. The data indicate that neither total serum proteins nor total real protein can be measured accurately by serum refractometry unless the total content of serum lipoproteins is considered. Serum refractometry can be done on one drop of serum and the procedure has been partly automated. NSA

N67-26769# California Univ., Berkeley. Lawrence Radiation Lab.
STUDIES ON DEFICIENT MAMMALIAN CELLS ISOLATED FROM X-IRRADIATION CULTURES
Paul W. Todd *In its* Biol. and Med. 1966 p 72–81 refs (See N67-26761 14-04)

Colonies of deficient cells appear in X-irradiated cultures of human as well as hamster cells. High-LET radiation was more effective than x radiation in the production of deficient cells, by the criterion of small-colony development. Deficient cells were respiratory deficient only to the extent that they consumed less oxygen than normal cells. Hamster cells did not express their inherited deficiencies visibly in their karyotypes. This does not conclude, however, that heritable chromosome aberrations cannot result in cellular deficiencies of the type described. NSA

N67-26772# California Univ., Berkeley. Lawrence Radiation Lab.
THE INTERPRETATION OF MICROBIAL INACTIVATION AND RECOVERY PHENOMENA
Robert H. Haynes *In its* Biol. and Med. 1966 p 97–116 refs (See N67-26761 14-04)
(Grant PHS-GM-12667)

Reproductive death in bacteria treated with X-rays, ultraviolet light, or nitrogen mustard arises primarily from the formation of structural defects in DNA serving to block normal DNA replication. The apparent radiosensitivity of cells can be increased by altering either the physico-chemical reactions involved in the formation of the defects or by interfering with the biochemical repair processes. Sensitization by interference with repair appears to be involved in at least three well-known radiobiological effects: (a) the existence of shoulders on survival curves; (b) the synergistic interactions that occur among uv, X-rays, and nitrogen mustard; and radiosensitization by agents that either bind or are incorporated into DNA (e.g., acridine dyes and halogenated base analogs respectively). Since repair is an enzymic, energy-requiring process, it can be attenuated by excessive DNA substrate damage, by direct attack on the repair enzymes, or by blockage of its energy supply. In general, it is difficult to distinguish among these three alternatives. Repair of uv damage in *E. coli* B/r is a multistep process involving nuclease excision of defective single-strand segments containing pyrimidine dimers, and a non-conservative mode of DNA replication which fills in the resulting gaps. Similarities in the relative sensitivities of *E. coli* B/r, B and B_{s-1} to uv and nitrogen mustard, the involvement of nucleases in repair, and the observation of repair replication after both uv and nitrogen mustard treatment lend strong support to the idea that it is not the damaged bases themselves that are recognized by the repair enzymes, but rather the associated secondary structural alternations in the phosphodiester backbone. Author (NSA)

N67-26773# California Univ., Berkeley. Lawrence Radiation Lab.
INACTIVATION OF PHAGE α BY SINGLE-STRAND BREAKAGE
David Freifelder *In its* Biol. and Med. 1966 p 117–122 refs (See N67-26761 14-04)

Bacillus megaterium phage α is more sensitive to x irradiation than a typical phage of its size containing double-stranded DNA. Double-strand breakage accounts for only a small part of the inactivation in contrast with many other phages. An ultracentrifuge assay was used to measure single-strand breakage in the DNA of the x-irradiated phages. The inactivating event is apparently a single-strand break. However, not all single-strand breaks are lethal. Two alternatives are possible: (1) a break is lethal only if it occurs in a particular strand or (2) only one strand can function in the cell, and this strand is selected at random. These alternatives cannot be distinguished by the present experiments. Author (NSA)

N67-26774# California Univ., Berkeley. Lawrence Radiation Lab.
REPLICATION OF DNA DURING F'LAC TRANSFER
David Freifelder *In its* Biol. and Med. 1966 p 123–127 refs (See N67-26761 14-04)
(Grant PHS-C-M-12667)

F'Lac is a DNA-containing (1) episomal element, which can be transferred from a male donor strain of the bacterium *E. coli* to a female recipient by conjugation. The mechanism by which this transfer occurs is not known. Suggested models for transfer are of three types: those for which DNA synthesis is unnecessary, those for which DNA synthesis accompanies transfer, and those for which DNA synthesis precedes transfer. In most investigations, the nature of the DNA transferred under normal conditions of DNA synthesis has been examined. The nature of the transferred DNA was studied in another way. If a thymine-requiring male transfers F'Lac in a medium containing 5-bromouracil deoxyriboside (BUDR) instead of thymine, the presence of BUDR in the transferred DNA can be detected by virtue of its sensitization to the effects

of short or long wavelength ultraviolet irradiation. DNA transferred without replication would be resolved as a fraction of F'Lac recipients relatively resistant to the irradiation. Experiments are described that show that, in agreement with the results of others, the transferred DNA has been replicated prior to or during transfer. Author (NSA)

N67-26775# California Univ., Berkeley. Lawrence Radiation Lab.
PLEIOTROPY AND POLYMORPHISM
Jack Lester King *In its* Biol. and Med. 1966 p 128–129 refs (See N67-26761 14-04)

Recent work in theoretical population genetics has demonstrated, principally through the use of computer simulation of Mendelian populations, that genetic polymorphisms can be maintained through interactions between various factors that do not singly effect polymorphic balance. Thus neither linkage alone nor stabilizing selection alone leads to stable genetic diversity, but together these factors can maintain a polymorphic equilibrium. The interactions of stabilizing selection and mutation in this respect, and the effects of triple interactions of linkage, epistasis, and inbreeding in the maintenance of genetic diversity are discussed. It is pointed out that multigenic systems cannot be dealt with by analyzing the isolated effect of any single variable. Other interacting variables must also be considered in turn: pleiotropy, temporal fluctuations in selection intensities, environmental clines, compensation, and more. It is suggested that pleiotropy is potentially a potent factor toward the maintenance of genetic diversity. A simple model demonstrating this in the interaction of pleiotropy and stabilizing selection is presented. NSA

N67-26776# California Univ., Berkeley. Lawrence Radiation Lab.
INCREASE IN PLASMA GROWTH-HORMONE LEVEL IN THE MONKEY FOLLOWING THE ADMINISTRATION OF SHEEP HYPOTHALMIC EXTRACTS
Joseph F. Garcia and Irving I. Geschwind *In its* Biol. and Med. 1966 p 130–136 refs (See N67-26761 14-04)
(Grant PHS-HD-00394)

Results are reported from a study on the effects of intravenously injected sheep hypothalmic extracts on the content of pituitary growth hormone in the blood plasma of monkeys (*Macaca mulatta*). It was concluded that the observations reported support the concept that the secretion of anterior pituitary growth hormone is mediated by a hypothalmic neurohumoral factor. NSA

N67-26876# School of Aerospace Medicine, Brooks, AFB, Tex.
PHYSIOLOGIC BASELINE STUDIES OF ZOOLOGIC SPECIMENS. PHYSIOLOGIC VALUES OF THE NORMAL IMMATURE CHIMPANZEE UNDER RESTRAINT
Bobby L. Caraway Dec. 1966 37 p refs
(SAM-TR-66-100; AD-648128) CFSTI: HC $3.00/MF $0.65

The effects of 24-hour restraint on normal physiologic values were studied in a group of eight young chimpanzees. Hourly recordings were made of body temperature, respiration rate, pulse rate, and blood pressure. Urine was collected by an indwelling catheter in increments of 6 hours to determine specific gravity, 24-hour volume, and biochemical assays for creatinine, sodium, potassium, 17-ketosteroids, 17-hydroxycorticosteroids, and total catecholamines. Four blood samples were taken: (1) at hour 0 beginning restraint, (2) at the 24th hour which ended restraint, (3) at hour 48, and (4) at hour 192. The effects of restraint plotted over an eight-day period depict fluctuations in the hematogram and serum biochemical values. An effort was made to correlate anxiety during restraint with variations in physiologic values. Most of the parameters under study did fluctuate during restraint and subsequently returned to baseline after release from restraint. Author (TAB)

N67-26895# School of Aerospace Medicine, Brooks AFB, Tex.
AN INITIAL INVESTIGATION OF THE EFFECTS OF PULSED IONIZING RADIATION ON THE PRIMATE EQUILIBRIUM FUNCTION
Donald J. Barnes Dec. 1966 19 p refs
(SAM-TR-66-106; AD-648671) CFSTI: HC $3.00/MF $0.65

A Primate Equilibrium Platform (PEP) was designed and constructed in order to ascertain the effects of pulsed ionizing radiation on the equilibrium function. Twelve rhesus monkeys were trained to maintain a platform-horizontal position by the manipulation of a joy stick. The experimental animals were transported to the Fast Burst Reactor (FBR) at White Sands Missile Range (WSMR), N. Mex., and were irradiated at that facility. The animals received an average midhead dose of 2,420 rads delivered in a microsecond pulse. Following irradiation, each animal was tested for 1 hour. The primary dependent variables were: (1) the time per trial spent on horizontal, and (2) the number of errors (deviations from horizontal) per trial. Results demonstrated a significant, though transient, early performance decrement. All experimental animals included in the final analysis demonstrated a recovery phenomenon subsequent to the early performance decrement. The results confirmed the equilibrium function to be relatively radiosensitive and worthy of further investigation. A modified PEP is projected for future experiments in order to more completely define the parameters of the radiation environment with respect to the equilibrium function. Author (TAB)

N67-26901# School of Aerospace Medicine, Brooks AFB, Tex.
AN ANALYSIS OF REPEATED MEASUREMENTS ON EXPERIMENTAL UNITS IN A TWO-WAY CLASSIFICATION, 1959–1966
Richard C. McNee (M.S. Thesis—Va. Polytech. Inst.) Oct. 1966 39 p refs Submitted for publication
(SAM-TR-66-86; AD-648381) CFSTI: HC $3.00/MF $0.65

In experiments with repeated measurements made on the same subjects, the repeated observations in time may be correlated. The assumption of independent observations, therefore, cannot be made in general. The paper considers the experimental design with treatments in a two-way classification with a disproportionate number of subjects allocated to each treatment combination and repeated measurements made on the subjects. A procedure is shown to be applicable for computing an analysis under somewhat restrictive assumptions. It is assumed that the variances are equal for all times and the correlations in time are equal. The tests obtained are for the three-factor interaction, the two-factor interactions assuming the three-factor interaction zero, and the main effects assuming all interactions zero. The procedure requires the inverse of one matrix, some matrix multiplication, and the calculation of some standard sums of squares. Author (TAB)

N67-26921# School of Aerospace Medicine, Brooks AFB, Tex.
PROCEEDINGS OF THE THIRTEENTH ANNUAL CONFERENCE OF AIR FORCE BEHAVIORAL SCIENTISTS
Charles L. Jennings and Carlos J. G. Perry, ed. Sep. 1966 421 p refs Conf. held at Lackland AFB, Tex., 12–14 Jan. 1966
(AD-648168) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. CLINICAL USE OF THE KTSA WITH CHILDREN: A CRITICAL ANALYSIS Richard R. Abidin p 1–5 refs

2. PSYCHIATRIC EVALUATION OF PERSONNEL FOR DETERMINATION OF ABILITY TO SECURE CLASSIFIED INFORMATION Harlan G. Alexander p 6–32 refs

3. COMMUNITY PSYCHIATRY AND THE AIR FORCE FAMILY: A PROSPECT Daniel H. Anderson p 33–44 refs

4. BEHAVIORAL RESPONSE OF PRIMATES TO PULSED GAMMA–NEUTRON RADIATION D. J. Barnes p 45–53 refs (See N67-26922 14-04)

5. SHORT-TERM GROUP TREATMENT OF LATE-ADOLESCENT AIRMEN A. W. Davis (Air Force Hospital) p 87–94 refs (See N67-26923 14-04)

6. USE OF AMPHETAMINES BY INDIVIDUALS IN CRITICAL OCCUPATIONS J. D. Griffith (Vanderbilt Univ.) p 142–148 (See N67-26924 14-04)

7. UNITED STATES AIR FORCE CHAP PROGRAM B. Hacker (Air Force Personnel and Training Res.) p 149–155 (See N67-26925 14-04)

8. MENTAL ILLNESS AMONG WOMEN IN THE AIR FORCE D. A. Halperin (Air Force Hospital) p 156–163 (See N67-26926 14-04)

9. ON PSYCHIATRIC TESTIMONY W. Higgins (Air Force Hospital) p 164–180 refs (See N67-26927 14-04)

10. THE HEWSON RATIOS REVISTED VIA THE WAIS C. L. Jennings p 181–194 refs (See N67-26928 14-04)

11. PRIVILEGED COMMUNICATION AND THE BEHAVIORAL SCIENTIST J. P. McGinty (Air Force Hospital) p 220–232 refs (See N67-26929 14-04)

12. ON MODIFYING BEHAVIOR: REFLECTIONS ON THE THERAPEUTIC PROCESS R. E. McKenzie (Federal Aviation Agency) p 233–243 (See N67-26930 14-04)

13. AIR FORCE PSYCHIATRY—1966 (THE BINDS THAT TIE) L. G. Nuernberger p 283–294 refs (See N67-26931 14-04)

14. SUITABILITY OF AF ROTC GRADUATES FOR FLYING ASSIGNMENTS: AN AREA OF POTENTIAL INVOLVEMENT FOR UNIVERSITY MENTAL HYGIENE CLINICS C. J. G. Perry p 295–303 refs (See N67-26932 14-04)

15. TREATMENT OF A PHOBIA BY BEHAVIOR MODIFICATION T. P. Pritchett (Air Force Hospital) p 304–308 (See N67-26933 14-04)

16. AN ADVANCED LIFE-SUPPORT CAPSULE FOR THE CHIMPANZEE M. Reite, L. Stephens, and O. Lewis (Aerospace Med. Div. Aeromedical Res. Lab.) p 309–327 refs (See N67-26934 14-05)

N67-26922# School of Aerospace Medicine, Brooks AFB, Tex.

BEHAVIORAL RESPONSE OF PRIMATES TO PULSED GAMMA-NEUTRON RADIATION

Donald J. Barnes *In its* Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 45–53 refs (See N67-26921 14-04)

Outlined is a behavioral response experiment on primates which will test their equilibrium function before and after exposure to pulsed ionizing gamma and neutron radiation. Rhesus monkeys, seated on a rotational device which rotates in two major axes, will be taught to control the pitch and roll of the platform with a stick. After the animal is trained to balance the platform sufficiently long, he will be irradiated and his subsequent behavior will be observed for any changes from the norm. G.G.

N67-26923# Air Force Hospital, Forbes AFB, Kan.

SHORT-TERM GROUP TREATMENT OF LATE-ADOLESCENT AIRMEN

Allen W. Davis *In* School of Aerospace Med. Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 87–94 refs (See N67-26921 14-04)

Group treatment for late-adolescent airmen was organized in order to help them to get along in their personal lives and on their jobs. Through group interaction they learned a mutual responsibility of helping each other with their problems, to achieve new growth and maturity in interrelating with other people, and to improve their ability to perform their jobs. Group therapy was halted after 12 meetings because the men were getting along so well that the supervisors wanted to terminate the treatment situation. G.G.

N67-26924# Vanderbilt Univ., Nashville, Tenn.

USE OF AMPHETAMINES BY INDIVIDUALS IN CRITICAL OCCUPATIONS

John D. Griffith *In* School of Aerospace Med. Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 142–148 (See N67-26921 14-04)

Considered are special problems related to the use of amphetamines in the United States Air Force as stimulant or psychotomimetic. Amphetamines are frequently prescribed for wartime and combat stress situations, emotional states associated with sudden and frequent transfer, disruption of family coherence, financial anxieties, and long waits for promotion. It seems that except for the first few days, amphetamines are little better than a placebo in the treatment of depressions. Important hazards in amphetamine treatment are drug-dependency and psychosis with abrupt states of frenzy and agitation. Military physicians should consider the possibility of drug-use in patients who are: (1) severely agitated or who have anxiety reactions; (2) individuals who seek amphetamines for weight reduction but do not seem to lose weight; (3) patients demonstrating abrupt personality changes; (4) patients with schizophrenic symptoms that clear up rapidly; and (5) when treating alcoholism. G.G.

N67-26925# Air Force Personnel and Training Research Center, Randolph AFB, Tex.

UNITED STATES AIR FORCE CHAP PROGRAM

Byron Hacker *In* School of Aerospace Med. Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 149–155 (See N67-26921 14-04)

The existing Air Force Handicapped Children Program is outlined to provide assistance for eligible military personnel who have unmarried children emotionally disturbed or physically or mentally handicapped and incapable of self-support. The possibility of humanitarian reassignment is pointed out, as well as additional allowance authorizations to help defray the extraordinary expenses incurred by families with handicapped children. G.G.

N67-26926# Air Force Hospital, Sheppard AFB, Tex.

MENTAL ILLNESS AMONG WOMEN IN THE AIR FORCE

David A. Halperin *In* School of Aerospace Med. Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 156–163 (See N67-26926 14-04)

Mental illness among WAFs seems to be treated differently from the way it is treated in other branches of the US Air Force, in that a higher degree of administrative flexibility is accorded commanders, and subsequent psychiatric hospitalization of WAFs is more usually indicative of severe pathology. Finally, being a WAF may well be a step toward health for the individual and given the more flexible administrative framework of the WAF, a step that the military psychiatrist can well respect. Author

N67-26927# Air Force Hospital, March AFB, Calif.

ON PSYCHIATRIC TESTIMONY

Warren Higgins *In* School of Aerospace Med. Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 164–180 refs (See N67-26921 14-04)

The author advocates that the military judge refer an offender for psychiatric evaluation in cases where there is no doubt that the accused performed the offense, but where there is a reason to suspect that mental or emotional factors played a significant role. The examining psychiatrist's report should include all relevant material obtained and relating to the understanding of the individual and his offense. Any significant mental or emotional condition present should be presented to the offense. The psychiatrist should also render an opinion as to whether the individual is rehabilitable or deterrable in the military setting, and include a recommendation for further medical treatment or discharge. G.G.

N67-26928# School of Aerospace Medicine, Brooks AFB, Tex.
THE HEWSON RATIOS REVISITED VIA THE WAIS
Charles L. Jennings *In its* Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 181–194 refs (See N67-26921 14-04)

Hewson ratios of psychological effects in head injuries were determined for subjects of the following diagnostic categories: (1) normal functioning personnel; (2) personnel with psychiatric problems; (3) rated officers with old head injuries; and (4) personnel hospitalized with head injuries. Results showed that approximately a third of each, the normal and neurotic groups, were identified as being organic; for the neurotic group only 7% were correctly identified. It was concluded that the Hewson ratios as originally defined contributed little to the differentiation and diagnosis of cerebral pathology, and that age was a significant factor for the normal group when compared with the other three groups ($P<.001$).
G.G.

N67-26929# Air Force Hospital, Lackland AFB, Tex.
PRIVILEGED COMMUNICATION AND THE BEHAVIORAL SCIENTIST
John P. McGinty *In* School of Aerospace Med. Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 220–232 refs (See N67-26921 14-04)

In order to keep privileged communications between social workers and clients confidential, a certification or registration seems to be necessary. Four states in the United States have officially certified social workers, but only one state has extended the privileged communication protection. To advocate certification in all states seems to be unwise since such licensing jeopardizes the standing and positions of untrained social workers.
G.G.

N67-26930# Federal Aviation Agency, Atlantic City, N. J.
ON MODIFYING BEHAVIOR: REFLECTIONS ON THE THERAPEUTIC PROCESS
Richard E. McKenzie *In* School of Aerospace Med. Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 233–243 (See N67-26921 14-04)

For behavioral change to occur in humans, there must be recognition of an unsatisfactory present adjustment and a desire to effect a corresponding change. All therapies must provide a therapeutic atmosphere and a framework for the basic components of the patient's behavior. The patient provides the building blocks from which the structure of his personality and its behavioral components are formed.
G.G.

N67-26931# Air Force Hospital, Lackland AFB, Tex.
AIR FORCE PSYCHIATRY—1966 (THE BINDS THAT TIE)
Louis G. Nuernberger *In* School of Aerospace Med. Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 283–294 refs (See N67-26921 14-04)

Projected are the various aspects of the psychiatrist's role in military life and the obvious difficulties he encounters in a closed, authoritarian system. This system where orders are issued from above and guidance is solicited from below has the disadvantage that, unless the right questions are asked from above downward, vital information may not proceed from below upward. As professional staff advisor the psychiatrist is obliged to provide information and guidance at all levels of command and to communicate effectively.
G.G.

N67-26932# School of Aerospace Medicine, Brooks AFB, Tex.
SUITABILITY OF AF ROTC GRADUATES FOR FLYING ASSIGNMENTS: AN AREA OF POTENTIAL INVOLVEMENT FOR UNIVERSITY MENTAL HYGIENE CLINICS
Carlos J. G. Perry *In its* Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 295–303 refs (See N67-26921 14-04)

A review of referral cases from the consultation service at the School of Aerospace Medicine showed psychiatric considerations to be more prevalent among ROTC graduates in the lieutenant group. This finding should be checked against sources of data outside the school. In the meantime, it may be a worthwhile venture to reappraise factors of motivation among students currently in ROTC training. Although it may be most difficult to approach, an appraisal of the policies of individual ROTC units could provide further insight into what I have described as an apparent problem.
Author

N67-26933# Air Force Hospital, Travis AFB, Calif.
TREATMENT OF A PHOBIA BY BEHAVIOR MODIFICATION
Thomas P. Pritchett *In* School of Aerospace Med. Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 304–308 (See N67-26921 14-04)

Described is the clinical therapeutic treatment of a phobia against open-field situations and large rooms by deep-relaxation of the subject. During the hypnotic-like trance, the patient was ordered to think of the most pleasant thought and to describe it. Fond memories and phantasy figures were abruptly terminated when the patient felt anxious in accordance with the extinction portion of the planned treatment procedure. In the course of seven sessions a complete symptom-free situation was obtained and the patient was able to engage in all forms of former fear-arousing situations.
G.G.

N67-26937# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TOXIC EFFECT OF HIGH OXYGEN PRESSURES ON THE ANIMAL ORGANISM
I. M. Ivanov and B. D. Kravchinskiy 20 Sep. 1966 24 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 17, no. 5, 1934 p 1019–1034
(FTD-TT-65-940; AD-646498) CFSTI: HC $3.00/MF $0.65

Blood transfusion from an animal subjected to compressed oxygen and showing a series of convulsive seizures did not produce an oxygen poisoning syndrome in the recipient in the small doses employed. At high oxygen pressures an increase in blood sugar is observed which is associated with an intensified muscular activity during the seizures. Thus, the hypothesis of a hypoglycemic character of the convulsions in oxygen poisoning must be discarded. In decerebrated animals (in which the thalamus opticus has not been removed) convulsive seizures in oxygen poisoning are not observed even at 8 atm. of oxygen. It is concluded that the site of damage of the central nervous system causing the convulsions in oxygen poisoning is the cerebral cortex. Preliminary hedonal anesthesia eliminates convulsive seizures in oxygen poisoning. The anesthesia must be sufficiently deep for this purpose. With a short exposure, the anesthesia produces a favorable outcome. Although the use of hedonal eliminates the seizures, it does not warrant an appreciable extension of the exposure, since a sufficiently prolonged action of compressed oxygen will inevitably produce acute inflammatory manifestations in the lungs causing death. In all cases, hedonal post-anesthesia stops seizures observed after removal from the chamber. However, the outcome of the oxygen poisoning depends on the magnitude of oxygen pressure and on the exposure, the species, and the individual resistance of the experimental animal. At 8 atm. pressure, the outcome is unfavorable, since the seizures recur after prolonged sleep and result in death.
Author (TAB)

N67-26944# Santa Rita Technology, Inc., Menlo Park, Calif.
RED-WINGED BLACKBIRD RESPONSES TO ACOUSTIC STIMULI
Gordon W. Boudreau Feb. 1967 38 p
(Contract F44620-67-C-0042)
(AFOSR-67-0717; AD-648967) CFSTI: HC $3.00/MF $0.65

A three-month study conducted at Moody Air Force Base, Georgia, revealed that Red-Winged Blackbirds in flight were sensitive to the compressor whine produced by jet engines on the T-37 training aircraft. Response to T-37 sounds was manifested by determined and often spectacular efforts to evade or avoid the sound field. Synthesized versions of the T-37 sounds with carrier frequencies ranging from 2500-3500 hertz, amplitude modulated by frequencies of 75-150 hertz, were more effective than the natural T-37 sounds. No inurement to T-37 sounds developed in the birds. The blackbirds failed to respond consistently to other acoustic stimuli, including other aircraft and their own natural alarm sounds, while in flight. However, natural alarm sounds were effective when projected to blackbirds feeding in fields or perched in trees. Unrelated species present failed to respond to T-37 sounds. Tests using acoustic barrier concepts were successful in re-routing the blackbirds normal flight patterns and the results suggest this may be feasible in alleviating the bird strike hazard at Moody Air Force Base. Author (TAB)

N67-26947# Human Factors Research, Inc., Santa Barbara, Calif.
THE OBJECTIVE IDENTIFICATION TEST: A STRESS-SENSITIVE PERCEPTUAL TEST Technical Report
William Harris Feb. 1967 31 p refs
(Contract Nonr-3135(00))
(TR-209-1; AD-648999) CFSTI: HC $3.00/MF $0.65

The purpose of this study was to develop additional items for the Object Identification Test (OIT), a test designed to measure some effects of environmental stress on human perceptual performance. Each item of the OIT consists of an ordered series of seven line drawings: the first drawing in a series presents a relatively ambiguous stimulus; details are added to successive drawings until, in the last drawing, an easily recognizable common object is pictured. The subject responds to each drawing of an item; his score is the drawing number on which he correctly identifies the object. Performance on the OIT involves central perceptual processes, and it is assumed that stress affects those processes. There is evidence that performance on the OIT is affected by at least three kinds of stress: intense noise exposure, noxious stimulation of test-related stimuli, and extended close confinement. Author (TAB)

N67-26970# System Development Corp., Santa Monica, Calif.
FOUNDATIONS OF A THEORY OF NEURAL MECHANISMS
Leonard Friedman 20 Jan. 1967 12 p refs
(SDC-SP-2702/000/00; AD-648753) CFSTI: HC $3.00/MF $0.65

The paper explains the underlying principles of a model of functional neural mechanisms that produce instinctive behavior. Two strong predictions of the theory are explained. One prediction is the existence of a functional unit or cell that can be replicated over and over again to produce a larger hierarchical organization of a behavior producing mechanism, very much as cells are joined to produce an organism. The second prediction is the existence of an extensive repertoire of neural units to produce and control units of motor behavior so that all movements of the organism are combinations of activated units selected from this repertoire. Evidence for this second prediction is cited from experiments on monkeys. Author (TAB)

N67-26972# Ohio State Univ., Research Foundation, Columbus.
VISUAL EFFECT OF HIGH INTENSITY FLASHES Quarterly Report, 15 May–15 Aug. 1966
Norma D. Miller 23 Aug. 1966 26 p
(Contract AF 41(609)-3078)
(Rept.-1; QR-1; AD-647339) CFSTI: HC $3.00/MF $0.65

Two main areas of investigation are the reciprocity between intensity and duration for flashes shorter than one millisecond; (The current study utilizes double flashes of 250 msec duration with intervals between the flashes varying from zero to 1 msec.) and the luminosity function for 45 monochromatic test flashes in the presence of 10-degree white light adapting fields of various luminances. TAB

N67-27008# School of Aerospace Medicine, Brooks AFB, Tex.
EFFECTS OF IONIZING RADIATION ON THE CONCENTRATION OF AMINO COMPOUNDS IN RAT PLASMA Technical Report, Jun. 1965–Jun. 1966
Charles E. Craft and Jack A. Winstead Jan. 1967 11 p refs
(SAM-TR-67-8; AD-648223) CFSTI: HC $3.00/MF $0.65

The concentrations of 28 different amino compounds were measured in the plasma of normal and irradiated rats. Preliminary results have indicated a 50% decrease in the concentration of the amino compounds during the first 24 hours, and an additional decrease was measured in the 48-hour postirradiated animals. There were two amino acids, lysine and serine, that showed the greatest decrease in concentration after radiation exposure. This preliminary study clearly indicated significant changes in the concentration of amino compounds in blood plasma after exposure to ionizing radiation. Author (TAB)

N67-27017# School of Aerospace Medicine, Brooks AFB, Tex.
TOXICOLOGY OF BORON HYDRIDES—STUDIES OF ALTERATIONS IN TISSUE AMINES BY TOXIC DECABORANE-14($B_{10}H_{14}$) AND PENTABORANE-9(B_5H_9) AS MODIFIED BY HYDRAZINES AND PROPYNYLAMINES Technical Report, Oct. 1963–Mar. 1966
Arthur A. Wykes and Juanita H. Landez Dec. 1966 17 p refs
(SAM-TR-66-112; AD-648537) CFSTI: HC $3.00/MF $0.65

Investigations of the influence of the toxic boron hydrides, decaborane-14 and pentaborane-9, on biogenic amine metabolism were undertaken to assist in the elucidation of the toxic mechanisms and sites of action of boron hydrides in animals. Brain and heart tissue serotonin and norepinephrine were found to be significantly depleted after treatment of test subjects with the boron hydrides. The testing of a number of potential antidotes for the treatment of the toxic symptoms and biogenic amine changes due to exposures to boron hydrides has resulted in the discovery of several new antidotal drugs for the toxic effects of decaborane-14. Pargyline (N-methyl-N-benzyl-2-propynylamine), a potent nonhydrazide monoamine oxidase (MAO) inhibitor, provides protection against the depletion of rat brain and heart norepinephrine, as well as the reserpine-like sedation and ataxia observed in decaborane-intoxicated rats. In contrast, several close analogs of pargyline do not protect against the depletion of tissue norepinephrine due to decaborane poisoning. JB-516 (1-phenyl-2-hydrazinopropane), a potent hydrazine-related MAO inhibitor, greatly potentiates the toxic effects of decaborane-14, as does iproniazid (1-isonicotinyl-2-isopropylhydrazine). Doses of the B6-vitamin pyridoxine also appear to counteract the toxic effects of decaborane-14. Monoamine oxidase inhibition and elevation of tissue amines per se by a drug do not appear to be required properties for the drug to decrease or eliminate the toxic actions of boron hydrides. Followup studies, which include investigations of the mode of action of pargyline and pyridoxine as protective agents in boron hydride-intoxicated animals, are in progress. Author (TAB)

N67-27043# Naval School of Aviation Medicine, Pensacola, Fla. Aerospace Medical Inst.
MORALE LEVEL AS A FUNCTION OF THE SUBJECT'S OWN DEFINITION OF MORALE
Rosalie K. Ambler and Everett R. Burnett 21 Nov. 1966 13 p refs
(NAMI-984; AD-648875) CFSTI: HC $3.00/MF $0.65

It was hypothesized that morale level as measured by a self-rating scale would vary as a function of the subjects own definition of morale. During the week of their graduation from training, 560 Naval aviation trainees were administered an

anonymous questionnaire that, among other things, asked them to give their own definition of morale. They were then instructed to note the morale of their own group in advanced training on a ten-point scale with their own definition as a frame of reference. A content analysis of the definitions was made, and three definition areas were identified. These can be described briefly as task oriented, group oriented, and feeling oriented. Mean morale rates were obtained for the subjects falling in each of the definition categories. Significant differences among this array of means were demonstrated. The task oriented group yielded the highest mean, with group oriented and feeling oriented following in that order. Hypotheses for further study were developed. Author (TAB)

N67-27077# Texas Christian Univ., Fort Worth. Inst. of Behavioral Research.
DIMENSIONS OF STIMULUS SITUATIONS WHICH ACCOUNT FOR BEHAVIOR VARIANCE Annual Progress Report
S. B. Sells 31 Dec. 1966 7 p refs
(Contract Nonr-3436(00))
(AD-647466) CFSTI: HC $3.00/MF $0.65

The general objectives of the studies undertaken center around the identification, isolation, and quantification of situational variables that account for substantial variance in behavior. The main thesis of the investigation is that behavior variance is a function of three universes of variables: (A) Individual differences (represented by measures of aptitude, interest, attitude, and personality), (B) Situational or environmental variables, (C) The interaction of individual differences and situational (environmental) variables, and that psychology has neglected the systematic study of the environment. The tasks discussed in this report involve: (A) Studies of dimensions of groups, (B) Stress reviews, (C) Exploration of variables descriptive of the environment, and (D) A survey of military psychologists' job satisfactions, based on a 20 per cent sample of membership of the American Psychological Association. Author (TAB)

N67-27202 Joint Publications Research Service, Washington, D. C.
ANTICHOLINE ESTERASE PROPERTIES O-H-ALKYL-S-BUTYL METHYL THIOPHOSPHANATES
A. A. Abduvakhabov, N. N. Godovikov, M. I. Kabachnik, S. S. Mikhaylov, V. I. Rozengart et al 10 Apr. 1967 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 171, no. 4, 1966 p 857–859
(JPRS-40572; TT-67-31216) CFSTI: $3.00

To determine the extent to which the anticholinesterase action O,S-dialkyl methyl thiophosphonate will change with the changing length of alkoxyl groupings, an analysis was conducted on O-H-alkyl-S-H-butyl methyl thiophosphonates. The value of bimolecular constant speeds of inhibiting cholinesterase was used to judge this anticholinesterase activity. The results show that the maximum anticholinesterase of the two series of combinations examined corresponds to the equal length of the alkoxylic and alkthyolic groups. This may indicate indirectly that the sorption of alkoxylic and alkthyolic groupings takes place in the same section of the ferment surface. M.G.J.

N67-27207 Joint Publications Research Service, Washington, D. C.
PSYCHOLOGY OF SETS AND CYBERNETICS
I. T. Bzhalava 4 Apr. 1967 68 p Transl. into ENGLISH from the book "Psikhologiya Ustanovki i Kibernetiki" Moscow, Nauka, 1966 p 1–250
(JPRS-40522; TT-67-31166) CFSTI: $3.00

A review is presented on a monograph which analyzes the set concept in relation to its interdisciplinary nature and its use as a logical basis for the theory of the functional organization of the brain. The experimental–theoretical investigation also attempts to connect the theory of sets with modern views about the organization of action, and the basic principles of cybernetics. The table of contents is listed, and the chapter on "Neurophysiological Bases of the Set" is reprinted. This discusses the connection of the image with the conditioning signal; the image as a signal for actuating the set; the motoric set concept; tentative reflex and the set; hierarchic states of sets; and the adaptation concept. M.G.J.

N67-27208 Joint Publications Research Service, Washington, D. C.
USE OF THE ELECTRON MICROSCOPE TECHNIQUE IN ONCOGENIC VIROLOGY
Janusz Groniowski 5 Apr. 1967 10 p refs Transl. into ENGLISH from Postepy Hig. Med. Doswiadczalnej (Warsaw), Jan.–Feb. 1965 p 77–82 Presented at the Warsaw Conf. on Oncogenic Viruses, Warsaw, 4 Apr. 1963
(JPRS-40538; TT-67-31182) CFSTI: $3.00

Summary information is presented on the use of electron microscope techniques in such research projects as (1) the ultrastructure of tumor viruses based on material purified and separated from its cell; (2) the relationship of the virus to the host cell, including penetration of the virus into the cell, localization in the cell, multiplication, and ultrastructural deviations in the host cell due to the influence of the virus; and (3) explorations in the tumorous cell of ultrastructures responding to infection with the virus. Limitations of the techniques are discussed, and it is pointed out that the method provides little data on the influence of the virus in the oncogenic process. M.G.J.

N67-27298*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY WITH INDEXES
Apr. 1967 78 p refs
(NASA-SP-7011(36)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Abstracts are presented of current literature dealing with the biological, physiological, psychological, and environmental effects related to simulated and actual flights in the earth's atmosphere or in interplanetary space. References to similar effects in lower forms of life are included, as are other topics related to the aerospace medicine and biology field. The latter includes studies in sanitation, safety and survival, pharmacology and toxicology, life support systems, exobiology, and personnel factors of interest to space flight researchers. Both a subject index and an author index are included for these references, which were previously announced in publications of NASA, the American Institute of Aeronautics and Astronautics, and the Aerospace Medicine and Biology Bibliography Project of the Library of Congress. M.W.R.

N67-27315*# National Aeronautics and Space Administration, Washington, D. C.
SYNTHESIS OF MEDIATORS OF THE SYMPATHETIC NERVOUS SYSTEM AND PIGMENTATION IN THE ONTOGENESIS OF VERTEBRATES [SINTEZ MEDIATOROV SIMPATICHESKOY NERVNOY SISTEMY I PIGMENTOOBRAZOVANIYE V ONTOGENEZE POZVONOCHNYKH ZHIVOTNYKH]
N. A. Smitten May 1967 14 p refs Transl. into ENGLISH from Zh. Obshch. Biol. (Moscow), v. 25, no. 1, 1964 p 51–61
(NASA-TT-F-10952) CSCL 06C

Morphological peculiarities of the catecholamine synthesis in the course of differentiation of chromaffin cells of vertebrates (mammalians, birds, and amphibia) are discussed. The formation time of chemically active adrenergic substances is shown to be similar to the time of the development of embryonic motor responses indicated in the literature. The interdependence of the synthesis of adrenergic substances and the pigment formation is proved by means of cell calculation and quantitative determination of

catecholamines in chromaffin cells in animals with different degree of pigmentation (white and black rats). The facts observed are explained by a common development of melanin-forming and chromaffin cells as well as by the products of their activity.
Author

N67-27355# Joint Publications Research Service, Washington, D. C.
BIONIC ASPECTS OF MEASUREMENT AND CONTROL OF ODORS
V. N. Okhotskaya 4 May 1967 8 p refs Transl. into ENGLISH from Avtometriya (Novosibirsk), no. 6, 1966 p 104–108
(JPRS-40900; TT-67-31542) CFSTI: HC$3.00/MF$0.65

Olfactory receptors with specific sensitivity to certain odors are discussed, and a set of n-dimensional characteristics for the evaluation of the quality of an odor is suggested. Based on electrophysiological and psychophysical experiments, expressions are presented for the quantity, quality, and mixing of aromas. It is pointed out that the intensity may change the quality of the odor, and that two odors may produce a third. It is suggested that absorption transducers might be used in construction of a multisensor device for objective evaluation of the quality and concentration of material vapors in the air.
N.E.N.

N67-27356# Joint Publications Research Service, Washington, D. C.
PREVENTION AND TREATMENT OF CAISSON DISEASE
N. N. Shchupakov 22 Mar. 1967 162 p refs Transl. into ENGLISH of the book "Profilaktika I Lecheniye Kessonnoy Bolezni" Moscow, 1962 187 p
(JPRS-40325; TT-67-30970) CFSTI: HC$3.00/MF$0.65

The problems of the etiology and pathogenesis of caisson disease are discussed, and the essential instructions concerning treatment of caisson lesions are given. Measures for prevention of the disease and for the organization of medical sanitation service in connection with caisson operations are emphasized. Data are published on the prevention of the disease by the method of breathing oxygen during decompression. Problems connected with saturation and desaturation of the organism are discussed in detail. The publication is intended to familiarize medical personnel on caisson construction sites with the particularities of labor safety and with those preventive measures which make it possible to substantially reduce incidence among workers. Only the basic preventive measures are examined, and only the recommendations for treating caisson disease which have been most fully verified are presented.
Author

N67-27357# Joint Publications Research Service, Washington, D. C.
PHYSIOLOGICAL MEASUREMENTS DURING SPACE TRAVEL
R. M. Bayevskiy 24 Mar. 1967 11 p Transl. into ENGLISH from Priroda (Moscow), no. 1, Jan. 1967 p 68–72
(JPRS-40381; TT-67-31026) CFSTI: HC$3.00/MF$0.65

The instrumentation and methods used to acquire physiological measurements are reviewed, emphasizing cardiological studies on the spacecrafts Vostok and Voskhod. Seismo-cardiographic tracings, pulse rate analysis, and variation of cardiac cycles and rate of heart contractions during weightlessness are outlined. The adaptation phases of the blood circulation system are described, and the alterations in motoractivity during writing are mentioned. Problem areas are identified as being a possibility of too many electrodes over the astronaut's body for greater mensuration and information, and the transmission of a sufficient volume of medical data over telemetering channels. The principal aspects to be applied for physiological mensurations during flights of long duration are indicated.
N.E.N.

N67-27358# Joint Publications Research Service, Washington, D. C.
MEDICAL SERVICES AND FACILITIES ON BOARD SPACE CRAFT
R. M. Bayevskiy 24 Mar. 1967 43 p Transl. into ENGLISH of "Sluzhba Zdorov'ya V. Kosmose" (Moscow), no. 15, 1966 p 1–43
(JPRS-40383; TT-67-31028) CFSTI: HC$3.00

Consideration is given to the various aspects of space medicine, including biotelemetry systems, the role of a physician on a space flight, spaceborne diagnostic machines, the relation between space medicine and clinical medicine, and the prevention of diseases in space. The need for more detailed information on the functioning of biological systems is stressed, as well as reactions to various conditions. The transmission and processing of physiological telemetry data are discussed, and details are given on a system of medical supervision by means of on-board computer equipment.
L.E.W.

N67-27373*# Nuclear Science and Engineering Corp., Pittsburgh, Pa.
STUDIES OF RADIOACTIVITY AND HYDROTHERMAL PROCESSES IN PROTOBIOCHEMISTRY ON EARTH AND THE MOON
R. L. Bogner, S. L. Hood, S. M. Somani, V. R. Zink, and E. R. White Mar. 1967 53 p refs
(Contract NASw-1508)
(NASA-CR-84414; NSEC-131) CFSTI: HC $3.00/MF $0.65 CSCL 06A

Studies have been performed that are related to abiogenic synthesis of protobiochemicals in a hydrothermal model system under the influence of ionizing radiation. A successful demonstration of the abiogenic formation of sulfur-containing organic compounds including sulfur amino-acids as well as a number of non-sulfur organic compounds was made. The model system concept envisions chemical abiogenesis proceeding on the primitive Earth in hot aqueous environments subjected to ionizing radiation. It is proposed that similar propitious geochemical events and conditions on the Moon and Mars, similar to those operative early in the history of the Earth, may be conductive to the formation of extraterrestrial organic compounds at the present time.
Author

N67-27381# Library of Congress, Washington, D. C. Aerospace Technology Div.
CHANGES IN THE TIGROID SUBSTANCE OF NEURONS UNDER THE EFFECT OF RADIO WAVES [ZMIŃY TYGROYIDNOYI RECHOVYNY NEYRONIV PID VPLYVOM RADIOKHVYL]
V. S. Bilokrynyts'kyy 25 Jan. 1967 17 p refs Transl. into ENGLISH from Fiziol. Zh. (Moscow), v. 12, no. 1, 1966 p 70–78
(ATD-67-3) CFSTI: HC$3.00/MF$0.65

Changes in the tigroid substance and in other components of nerve cells in the cerebrum and spinal cord of cats subjected to a superhigh-frequency field, were studied. Neuron groups situated in the anterior, lateral, and posterior corners of the spinal cord; neurons in the cerebral hemispheres (motion, sensory, and other sections); neurons of subcortical formations and of the brain stem; cortical neurons; neurons of the nuclei of the cerebellum; and neurons of some intervertebral ganglions were investigated according to the outlined experimental procedure. Observations of the changes found from the experiments are discussed; and comparisons with observations reported in the literature are made.
L.S.

N67-27387# Joint Publications Research Service, Washington, D. C.
PHYSIOLOGY OF WORK IN SPACE
L. S. Khachatur'yants 24 Mar. 1967 11 p Transl. into ENGLISH from Med. Sestra (Moscow), no. 1, Jan. 1967
(JPRS-40399; TT-67-31044) CFSTI: HC$3.00

An account of physiological and emotional reactions occurring in the cosmonauts during their performance of tasks on the Voskhod-2 space flight is presented. Respiration and cardiac contraction rate data obtained throughout the flight are graphically depicted; and changes corresponding to various task events are noted. L.S.

N67-27390# Joint Publications Research Service, Washington, D. C.
IMAGE RECOGNITION
V. S. Fayn 1 May 1967 16 p Transl. into ENGLISH from Priroda (Moscow), no. 2, Feb. 1966 p 18–26
(JPRS-40835; TT-67-31478) CFSTI: HC $3.00/MF $0.65

A mathematical technique by which images may be recognized by sets of points based on approximation functions, whose graphs in space constitute families of lines is described. The equations of these functions also express the regularities in the sets of points generated by the images, and thus express the regularities in the set of images themselves. Practical applications of the technique (reading machines, oscillograms of word sounds, etc.) are discussed. L.S.

N67-27391 Joint Publications Research Service Washington, D. C.
METHOD OF PROGRAMMED PHYSIOLOGICAL MEASUREMENTS AND EXPERIENCE OF ITS USE ON THE "VOSKHOD" SPACESHIP
R. M. Bayevskiy and D. G. Maksimov 1 Mar. 1967 22 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 4, no. 5, 1966 p 768–780
(JPRS-40075; TT-67-30722) CFSTI: $3.00

The authors describe the general principles of a method for programmed physiological measurements during space flight, and the stages of its laboratory development. Several variants of the research programs are given. Special attention is given to the work capacity of cosmonauts. The results of programmed investigations during the flight of the Voskhod ship are given. Author

N67-27394# Joint Publications Research Service, Washington, D. C.
SOME CARDIOVASCULAR AND RESPIRATORY REACTIONS OF THE CREWMEN DURING THE VOSKHOD-2 ORBITAL FLIGHT
I. I. Kas'yan, P. V. Vasil'yev, D. G. Maksimov, I. T. Akulinichev, A. Ye. Uglov et al 8 Mar. 1967 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 1, 2, Jan.–Feb. 1967 p 104–115
(JPRS-40179; TT-67-30825) CFSTI: HC $3.00

Electrocardiographic, pulse and respirations rate, body temperature, and seismocardiographic data concerning the condition of the cardiovascular and respiratory systems of the astronauts P.I. Belyayev and A.A. Leonov during their flight in the spaceship Voskhod-2, are summarized. The data are also depicted by curves. No severe changes in the state of the basic functional system of the organism, and no noticeable reduction of the level of their performance of work were indicated. Belyayev manifested a more pronounced reaction of the cardiovascular and respiratory systems during the second orbital turn (when the second pilot entered the lock) and during the 17th orbital turn (when Belyayev performed manual control of the spaceship). Leonov showed a more pronounced reaction during the period of free floating in space and at the moment of his return aboard the ship (2nd orbit). These changes were predominantly connected with the emotional tension during performance of the most important tasks of the flight program. L.S.

N67-27435*# Naval School of Aviation Medicine, Pensacola, Fla.
FACTORS CONTRIBUTING TO THE BALLISTOCARDIOGRAPHIC WAVE FORM IN HEALTHY MIDDLE AGED MALES
David H. Jackson, Albert Oberman, Robert E. Mitchell, and Ashton Graybiel May 1966 41 p refs
(NASA Order R-136)
(NASA-CR-84436; NAMI-966) CFSTI: HC $3.00/MF $0.65 CSCL 06N

The availability of a large number of variables derived from clinical and laboratory evaluations of 200 middle aged males made it possible to relate them statistically to the BCG waves. Numerous significant correlations were found and these are discussed. It appears that, until the factors and their interrelationships are more precisely evaluated, the strictly quantitative use of BCG standards derived from groups to determine such things as stroke volume, among others, must be regarded with caution. The results seem to indicate that serial BCG's will be necessary for complete evaluation of an individual's cardiovascular status. Author

N67-27436*# Naval School of Aviation Medicine, Pensacola, Fla.
VECTORCARDIOGRAPHIC CHANGES DURING INTRACORONARY INJECTIONS
Raphael F. Smith, J. Warren Harthorne, and Charles A. Sanders 13 Feb. 1967 30 p refs
(NASA Order T-23237)
(NASA-CR-84435; NAMI-995) CSCL 06P

To determine mechanisms of myocardial toxicity of radiopaque media and to correlate specifically induced changes in the composition of coronary artery blood with the changes in the surface electrocardiogram simultaneous recordings were made from Frank leads X, Y, and Z during intracoronary injections of radiopaque media and special test solutions in 19 patients. It is concluded that the resulting T wave changes were caused by regional prolongation of the repolarization process, presumably due to extracellular sodium excess or sodium–calcium antagonism. Delay of the repolarization process and the resulting potential difference may be responsible for reentrant excitation and the ventricular arrhythmias observed during coronary angiography. Author

N67-27541# Occupational Health Research and Training Facility, Cincinnati, Ohio.
SENSIBLE AND LATENT HEAT LOSSES FROM OCCUPANTS OF SURVIVAL SHELTERS Final Report
Clark M. Humphrerys, Austin Henschel, and Douglas H. K. Lee Washington, Public Health Serv., Dec. 1966 33 p refs
(Contract OCD-P5-64-126)
(AD-648467) CFSTI: HC $3.00/MF $0.65

Six figures have been prepared showing the sensible and latent heat exchange rates from clothed and nude individuals at various environmental conditions and at three metabolic rates. Data are also included by which the heat exchange rates for the standard individual may be corrected for non-standard groups. Author (TAB)

N67-27611*# Scientific Translation Service, La Canada, Calif.
PAPERS OF THE DVL-INSTITUTE FOR AERO-MEDICINE PRESENTED AT THE SIXTH INTERNATIONAL AND TWELFTH EUROPEAN CONGRESS OF AVIATION AND SPACE MEDICINE IN ROME, 1963 AND AT THE THIRTEENTH INTERNATIONAL CONGRESS OF AVIATION AND SPACE MEDICINE IN DUBLIN, 1964 [VORTRAEGE AUS DEM INSTITUT FUER FLUGMEDIZIN GEHALTEN AUF DEM VI. INTERNATIONALEN UND XII. EUROPAEISCHEN KONGRESS FUER LUFT- UND RAUMFAHRTMEDIZIN IN ROM 1963 UND DEM XIII. INTERNATIONALEN KONGRESS FUER LUFT- UND RAUMFAHRTMEDIZIN IN DUBLIN 1964]
W. Briegleb Washington, NASA, Jun. 1967 29 p refs Transl. into ENGLISH of DLR-FB-65-40, 1965
(Contract NASw-1496)
(NASA-TT-F-10957) CFSTI: $3.00 CSCL 06S

Aeromedicine subjects discussed are: therapy against decompression sickness, adaption to an unspecific stress, the mechanism of the serous stress reaction, the biochemical primary effects in radiation damage, clinical picture of the shifted diurnal rhythm during jet flights, explosion and decompression injuries, the influence of weightlessness in cell functions. Author

N67-27626*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

SELECTED STUDIES IN EXOBIOLOGY, PLANETARY ENVIRONMENTS, AND PROBLEMS RELATED TO THE ORIGIN OF LIFE Semiannual Progress Report, 1 Oct. 1966–31 Mar. 1967

Carl Sagan May 1967 8 p refs
(Grant NGR-09-015-023)
(NASA-CR-84461; SAPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Theoretical work centered on: the development of a wind-blown dust model of Martian seasonal and secular changes, the contribution of protons from solar wind to Martian atmosphere ionization, calculations of temperature distributions on airless planets, and improved green house models of planetary atmospheres. Observational work covered the successful testing and new data collection with a planetary camera at the temperature distributions on airless planets, and improved green house models of planetary atmospheres. Observational work covered the successful testing and new data collection with a planetary camera at the 82-inch reflecting telescope of Mercury, Venus, Mars, and Jupiter, as well as UBV photography; attempts to detect elevation differences on Mars from CO_2 absorption lines were unsuccessful. Laboratory work consisted in completion of a combined distillation system and gas handling apparatus with pressure capabilities of 10^{-6} mm mercury; the system employs a magnetic piston and continuously dissolves synthesized gases in liquid water while avoiding boiling. G.G.

N67-27674*# IIT Research Inst., Chicago, Ill.

LIFE IN EXTRATERRESTRIAL ENVIRONMENTS Quarterly Status Report, Feb. 15–May 31, 1967

May 1967 40 p
(Contract NASr-22)
(NASA-CR-84516; IITRI-L6023-9) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Soil ecology experiments on microorganism growth response in different soils were completed. Factors related to an organism's growth and survival probability in soil which, in turn, is related to the probability of extraterrestrial contamination, were studied as well as available moisture and a constant or daily fluctuating freeze-thaw incubation temperature. Brunizemic, desertic, and podzolic soils provided substrates with different pH's, organic content, soluble cations, and clay content. The brunizemic soil provided the best substrate for the growth and survival of *Bacillus cereus*, *Lactobacillus plantarum*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Streptomyces albus*. *L. plantarum*, *S. aureus*, and *S. albus* grew in the podzolic soil, while *B. cereus*, Putrefactive Anaerobe (PA 3679), and *S. albus* survived in the desert soil. The daily freeze-thaw cycles enhanced the growth and survival of *S. aureus* and *L. plantarum* in the brunizemic and podzolic soils. The growth responses of organisms in the podzolic soil were about 1 log lower than their growth in brunizemic soil. R.N.A.

N67-27678*# Cedars of Lebanon Hospital, Los Angeles, Calif. Inst. of Medical Research.

A TECHNIQUE FOR TESTING HEART FUNCTION BY ANALYSIS OF ITS VIBRATION SPECTRUM Progress Report, 31 Dec. 1966–31 Jun. 1967

Clarence M. Agress Jun. 1967 4 p
(Grant NsG-289)
(NASA-CR-84512) CSCL 06P

A previously described method for indirectly determining stroke volume by isovolumetric contraction and ejection periods was extended to a new series of human subjects. In this current study the vibrocardiogram was used to measure the cardiac intervals and the dye dilution technique used to measure cardiac output in 10 normal subjects and 11 patients recovering from acute myocardial infarction. The correlation between the vibrocardiographic method and the dye output was highly significant ($r=0.90$), substantiating our previous observations. A preliminary design of an analog computer model of the left heart was made to test the cardiac interval—stroke volume correlation on a theoretical basis. Author

N67-27679*# Cedars of Lebanon Hospital, Los Angeles, Calif.

MEASUREMENT OF STROKE VOLUME BY THE VIBROCARDIOGRAM

Clarence M. Agress, Stanley Wegner, Robert D. Fremont, Izumi Mori, and Dixie J. Day [1967] 25 p refs
(Grant NsG-289)
(NASA-CR-84513) CSCL 06P

An examination was made of the relationship between stroke volume measured by dye dilution and left ventricular isovolumetric contraction and ejection times as measured by the vibrocardiogram. These studies were performed in 10 normal subjects under postural alterations, and in 11 patients recovering from acute myocardial infarction. Regression analyses of the data showed that ejection time was highly correlated with stroke volume ($r=0.84$), while use of both ejection time and isovolumetric contraction time improved correlation to $r=0.90$. Similar correlations were obtained comparing changes in stroke volume with changes in the intervals. It was concluded that the VbCg provides a simple, non-traumatic method for the estimation of stroke volume. Author

N67-27698# Institute for Perception RVO–TNO, Soesterberg (Netherlands).

THE ELECTRORETINOGRAPHIC RESPONSE TO WEAK STIMULI OF LARGE SUBTENSE II

N. M. J. Schweitzer and P. Padmos [1966] 27 p refs
(IZF-1967-5; TDCK-47885) CFSTI: HC $3.00/MF $0.65

Recent data on the electroretinographic (ERG) responses of the dark adapted eye are presented, and the results are analyzed in terms of components and subcomponents of the near-threshold ERG. Rectangular pulses, 500–1000 millisec long, were produced on a television tube, and were repeated every 2 or every 4 seconds. The method of averaging responses to exclude errors and artifacts is described, and the results are discussed in detail. The components determined are: (1) a positive dc component, which may be newly discovered or identical to previously described components; (2) a negative potential, which possibly is the late rod receptor potential; and (3) three subcomponents, which probably represent spatial interactions in the retina. N.E.N.

N67-27707*# Woods Hole Oceanographic Institution, Mass.

AMINO ACIDS AND AMINO SUGARS IN CALCIFIED TISSUES OF PORTUNID CRABS

Francis G. Carey, Derek W. Spencer, and Egon T. Degens [1967] 14 p refs
(Contract NSR-22-014-001; Grant NSF G-816)
(NASA-CR-84429) CFSTI: HC $3.00/MF $0.65 CSCL 06A

The amino acid and amino sugar composition of representative regions in the exoskeleton were determined and these data were related to the calcification phenomena. The regions sampled were the soft uncalcified joint membrane between the carpus and merus of the cheliped, the flexible paddle of the pleopod, the cardiac and gastric regions of the carapace, the propodus, and dactylus of the cheliped. All samples were freed of extraneous tissues and subjected to decalcification, hydrolysis, and ion-exchange chromatography. Data on calcium, magnesium, and strontium obtained by atomic absorption spectroscopy and on phosphate by colorimetry were used as a measure of the degree of calcification of the individual organic matrix. C.T.C.

N67-27723# Joint Publications Research Service, Washington, D. C.
MECHANISM OF MEMORY
A. Turov 5 Apr. 1967 15 p ref Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 2, 1967 p 40–47)
(JPRS-40357; TT-67-31181) CFSTI: $3.00

Presented is an analysis of the current status of research on the memory mechanisms of the human brain. Cited are studies of the relationship between memory based on comprehension, and that not based on comprehension; the localization of the different types of memory (short-term and long-term) in the human central nervous system; the so-called retroactive inhibition phenomenon; the bioelectrical activity of both individual brain formations and individual neuron groups; experimental models of nerve networks which explain how individual neurons are linked together so as to remember the characteristics of old signals and recognize new signals; the evolution of memory mechanisms in lower forms; conditioned reflexes in planarians; and the role of ribonucleoproteins in memory processes. It is surmised that close collaboration between neurophysiology and histochemistry, biochemistry, mathematics, and the present day analysis of clinical findings will assist in the solution of fundamental aspects of memory and subsequently the development of effective computer memory storage units.
S.C.W.

N67-27772 Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET BIOTECHNOLOGY AND BIOASTRONAUTICS, JANUARY 1966–JUNE 1966 Surveys of Foreign Scientific and Technical Literature
6 Mar. 1967 167 p refs
(ATD-67-13)

Abstracts covering the following general subject areas are presented: 1) Altered gravity, accelerations, vestibular reactions, extravehicular movement, and training for altered gravity conditions, 2) Noise, vibration, and ultrasound, 3) Radiation effects and dosimetry, 4) Biomedical effects of radio frequency and magnetic fields, 5) Hypothermia, clinical death, and reanimatology, 6) Altered gas environments, 7) Astrobotany, exobiology, closed ecological systems, hydroponics, and algae, 8) Modeling of biological processes, human engineering, and man-machine factors, 9) Biomedical monitoring and biotelemetry, 10) Kosmos-110 biosatellite experiments, 11) manned flight results from Voskhod-1 and Voskhod-2, and 12) Soviet plans and prospects for manned flight. An alphabetical author index appears at the end of the text.
L.S.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N67-26542*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYSIS OF SELF-LOCOMOTIVE PERFORMANCE OF LUNAR EXPLORERS BASED ON EXPERIMENTAL REDUCED-GRAVITY STUDIES
Donald E. Hawes Washington, NASA, May 1967 21 p refs
(NASA-TN-D-3934) CFSTI: HC $3.00/MF $0.65 CSCL 06K

An analysis of some measurements of metabolic costs of various lunar and corresponding earth locomotive activities has been made to determine the performance capabilities of man in carrying out lunar exploration. Comparisons of limited data from different sources have been made to establish the validity of the data obtained in simulated lunar gravity and used as the basis of this analysis. Various factors such as fatigue limit of the subjects, duty cycle, speed of locomotion, and lunar surface slope have been taken into account. The results of the analysis indicate that the performance of the lunar explorer will be significantly greater than that of his earthly counterpart wearing the same equipment, and that there is a very great need for evaluating the pressure suits actually intended for lunar locomotive activities in the simulated lunar gravity condition because of the gross effects of gravity on the locomotive performance.
Author

N67-26551*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THERMAL CONTROL CONSIDERATIONS FOR A MANNED ORBITING SPACE STATION
J. Thomas Taylor Washington, NASA, May 1967 48 p
(NASA-TN-D-3995) CFSTI: HC $3.00/MF $0.65 CSCL 22A

This report analyzes the advantages of combined passive and active methods for the thermal control of a Manned Orbital Laboratory. The object was the reduction of the space radiator heat load by rejecting the heat into space through the module walls. This was done by using external surface coatings. Analyses were conducted on two laboratories, each with crews of 18 and 24 men, at three different power levels. A combination passive and active system is recommended.
Author

N67-26567*# National Aeronautics and Space Administration, Washington, D. C.
MODELLING ENERGY EXCHANGE PROCESSES IN ECOLOGICAL SYSTEMS [MODELIROVANIYE PROTESSES-SOV ENERGOOBMENA V EKOLOGICHESKIKH SISTEMAKH]
A. B. Rubin Nov. 1966 5 p refs Transl. into ENGLISH of a paper presented at the 17th Intern. Astronautical Congr., Madrid, 9–15 Oct. 1966
(NASA-TT-F-10408) CFSTI: $3.00 CSCL 06K

A discussion is presented on the mathematical modelling of the process of energy exchange between separate links in an ecological complex. An artificial ecological complex is viewed as a closed system, with energy and mass exchange being a sequential, branched chain. A chain consisting of three components is considered as an example.
Author

N67-26575*# National Aeronautics and Space Administration, Washington, D. C.
THE PROBLEM OF PROLONGED, AUTONOMOUS HUMAN EXISTENCE IN A SPACE SUIT [K PROBLEME DLITEL'NOGO AUTONOMNOGO SUSHCHETSTVOVANIYA CHELOVEKA V KOSMICHESKOM SKAFANDRE]
A. M. Genin and L. G. Golovkin Nov. 1966 9 p Transl. into ENGLISH of a paper presented at the 17th Intern. Astronautical Congr., Madrid, 9–15 Oct. 1966
(NASA-TT-F-10413) CFSTI: $3.00 CSCL 06K

The feasibility of maintaining the thermal balance of a cosmonaut in a space suit utilizing only physiological perspiration is considered. Two series of tests were conducted in a thermal pressure chamber to determine the degree of intensity of physiological heat control and the performance capacity and the general condition of an organism. On the basis of the experiments it is asserted that for a period of 3 to 4 hours a man in a space suit is able to dissipate by the evaporation of perspiration 200–220 kcal/hr of heat produced either internally or externally. When the total thermal load is decreased, the duration a man can withstand such condition is greatly increased.
Author

N67-26578*# National Aeronautics and Space Administration, Washington, D. C.

AN EXPERIMENT IN USING MICROCUVETTES MANUFACTURE OF THIN GLASS STRIPS, PLATES, AND COVER GLASSES BY DRAWING SHEET GLASS [OPYT PRIMENENIYA MIKROKYUVET. IZGOTOVLENIYE TONKIKH STEKLYANNYKH LENT, PLASTIN I POKROVNYKH STEKOL RASTYAGIVANIYEM LISTOVOGO STEKLA]

B. V. Perfil'yev and D. R. Gabe Feb. 1967 19 p Transl. into ENGLISH from the book "Capillary Methods of Investigating Microorganisms" Moscow, Izd. Akad. Nauk SSSR, 1961 p 213–221, 463–470

(NASA-TT-F-10728) CFSTI: HC $3.00/MF $0.65 CSCL 06L

A description of a special inovulation chamber for implanting isolated microbe cells is given. The microcuvettes are designed for growing cultures and observation under a microscope. The second article reviews plate glass manufacture in the USSR, and discusses the fabrication of microscope cover glasses. Author

N67-26599*# National Aeronautics and Space Administration, Washington, D. C.

MEASUREMENT OF LOW FREQUENCY VIBRATIONS IN BIG HELICOPTERS AND THEIR TRANSMISSION TO THE PILOT [MESURE DES VIBRATIONS DE BASSE FREQUENCE SUR HELICOPTERE LOURD ET LEUR TRANSMISSION AU PILOTE]

H. Seris and R. Auffret May 1967 16 p refs Transl. into ENGLISH from the book "AGARD Collected Papers Presented at the 22nd Meeting of the AGARD Aerospace Medical Panel" Sep. 1965 p 245–257

(NASA-TT-F-471) CFSTI: HC $3.00 CSCL 05H

Analyses are presented of the vibrations recorded at the seat level and on the sternum and cranium of the pilot. Sources are identified as (1) very low frequency vibrations due to atmospheric turbulence occurring at low altitudes and in clouds; and (2) vibration caused by mechanical factors in the main rotor and the anti-torque rotor. The frequencies transmitted to the cockpit are multiples of the number of blades of the frequency of rotor rotation. The helicopter used produced mechanical vibrations of 20 Hz and above, caused principally by the main rotor. The damping function of the body upon increased frequencies is demonstrated, with the resonant frequencies of the human body found in the 4 to 6 Hz region in seated subjects. Between 25 and 30 Hz, an over-acceleration of the head in relation to the shoulder was observed. Author

N67-26625*# National Aeronautics and Space Administration, Washington, D. C.

PROBLEMS OF BIOTELEMETRY DURING PROLONGED SPACE FLIGHTS [PROBLEMY BIOTELEMETRII V DLITEL'-NYKH KOSMICHESKIKH POLETAKH]

I. T. Akulinichev, A. M. Zhdanov, and I. I. Popov Nov. 1966 11 p Transl. into ENGLISH from Russian Presented at the 17th Intern. Astronautical Cong., Madrid, 9–15 Oct. 1966

(NASA-TT-F-10404) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Some of the problems encountered in the use of the telemetry and other information-measuring devices on future spaceships are discussed. Results are presented from investigations conducted for the purpose of perfecting means for the improvement of space flight safety. A discussion is given on the selection of physiological, hygienic, and psychomotor parameters needed to carry out scientific research and other tasks on spacecraft. Author

N67-26626*# National Aeronautics and Space Administration, Washington, D. C.

AN INFORMATION MODEL OF THE EXTRAVEHICULAR DYNAMICS OF COSMONAUT BODY MOVEMENTS AND SPATIAL ORIENTATION [INFORMATSIONNAYA MODEL' DINAMIKI DVIZHENIYA I PROSTRANSTVENNAYA ORIENTIROVKA KOSMONAVTA VNE KORABLYA]

V. A. Popov, Yu. A. Rozanov, and M. M. Sil'vestrov Nov. 1966 7 p Transl. into ENGLISH from Russian Presented at the 17th Intern. Astronautical Cong., Madrid, 9–15 Oct. 1966

(NASA-TT-F-10407) CFSTI: HC $3.00/MF $0.65 CSCL 05H

An investigation of an information model of the extravehicular dynamics of cosmonaut body movements and spatial orientation is discussed. It is found that a cosmonaut's individual movement control system must include motors to ensure rotation with respect to three mutually perpendicular axes and linear movement, controls, stabilization circuits, and an information model which provides the cosmonaut with data on spatial orientation and movement parameters. Detailed treatment is given to the information model of the control process. Author

N67-26681# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ENGINEERING PSYCHOLOGY

A. N. Leont'yeva, V. P. Zinchenko, and D. Yu. Panova 31 Oct. 1966 719 p refs Transl. into ENGLISH of the book "Inzhenernaya Psikhologiya" Moscow, Izd. Mosk. Univ., 1964 p 1–396

(FTD-HT-66-147; TT-67-61001; AD-646960) CFSTI: HC $3.00/MF $0.65

An engineering psychology textbook dealing with human operator performance, sensory perception, and information theory related to automatic control systems is presented. For individual titles see N67-26682–N67-26700. M.W.R.

N67-26682# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEMS OF ENGINEERING PSYCHOLOGY

V. P. Zinchenko, A. N. Leont'yeva, and D. Yu. Panova *In its* Eng. Psychology 31 Oct. 1966 p 2–37 refs (See N67-26681 14-05)

Man is considered as the subject of working activity or as a special link in automated systems, and the general characteristics of his activities in an automated control system are discussed. The main task of engineering psychology is determining the capacity of the human operator with information control models that represent real devices. Effective encoding of information and the speed of perception are discussed, and a sequence is listed for the creation of a language for an automated system. Problems of contemporary engineering psychology are noted. M.W.R.

N67-26683# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GENERAL CONCEPTS OF INFORMATION THEORY AND THEIR APPLICATION IN PSYCHOLOGY AND PSYCHOPHYSIOLOGY

L. V. Fatkin *In its* Eng. Psychology 31 Oct. 1966 p 38–70 refs (See N67-26681 14-05)

Basic concepts of information theory are described in terms of applicability to psychological and psychophysiological research. Since all cases of transmitting qualitatively different data must be reduced to a generalized abstract system of communication lines, the functional parts of a block diagram to accomplish this are detailed. The quantitative evaluation of information is then discussed, as are the transmission of signals along the communications channels and the psychophysiological peculiarities of human perception. The "throughput capacity" of the human sensomotor systems is considered, and various experimental results are cited. Rate of information perception, the mechanism of eye movements, and the existence of an inertial visual image are discussed. M.W.R.

N67-26684# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STATISTICAL ANALYSIS OF PERCEPTION PROCESSES

L. V. Fatkin *In its* Eng. Psychology 31 Oct. 1966 p 71–89 refs (See N67-26681 14-05)

A geometrical model of a generalized system for the transmission and reception of messages permits the three-dimensional study of fairly complex perception mechanisms. Recognition of phonemes, study of the tactile analyzer, and analysis of a perception model are discussed; and mathematical methods for estimating the quantity of received information are considered. M.W.R.

N67-26685# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF QUANTITATIVE ANALYSIS OF THE PERCEPTION OF SPATIAL AND SPATIO-TEMPORAL RELATIONS

V. Ya. Dymerskiy *In its* Eng. Psychology 31 Oct. 1966 p 90–122 refs (See N67-26681 14-05)

Perception of the spatial and spatio-temporal interrelationships of objects are considered as system elements; and the mapping of these characteristics is discussed. Direct mapping of the system elements are termed sensation, while the indirect mapping is referred to as perception. Attention is given to the accuracy of perceptive processes, as well as to thresholds for feeling and perception; and a quantitative analysis is made of the processes of indirect mapping of characteristics of the elements in a system. Accuracy and reliability of perception methods are considered. M.W.R.

N67-26686# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STATISTICAL MODEL OF THE OBSERVER

Ye. N. Sokolov *In its* Eng. Psychology 31 Oct. 1966 p 123–188 refs (See N67-26681 14-05)

The application of statistics to signals and reactions is treated in terms of the observer and the schematization of his activities, and the theory of an ideal observer is discussed. Methods of tracking stimuli, sources of fluctuation in observer response, and criteria for actual and false responses are discussed. Since the peculiarities of observer activity are not external manifestations of mental activity aimed at the detection and recognition of signals, the use of electroencephalography is suggested as an approach to the study of human responses. Statistical structure of the working level of observer performance is considered, along with fluctuations and EEG response thresholds. Fluctuations of the "inherent light of the retina", artificially introduced and naturally established working level, and effective absolute threshold are examined. The concepts of effective absolute threshold and true absolute threshold are introduced. M.W.R.

N67-26687# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHODS AND SYSTEMS OF AUTOMATIC ANALYSIS OF BRAIN BIOCURRENTS

V. D. Nebylitsyn *In its* Eng. Psychology 31 Oct. 1966 p 189–219 refs (See N67-26681 14-05)

Computerized and other automatic methods for the analysis of brain biocurrents are discussed in light of various experimental studies in the literature. Frequency analyses of the electroencephalograms are considered, along with the use of autocorrelation and cross correlation methods. Detection of elicited potentials obtained on animals under narcosis and immobilized with curare indicate both specific and nonspecific electrical responses in the cortex and other brain structures. New developments in electroencephalography are noted, including the use of periodometric analysis of EEGs. Use of digital computing techniques for analysis of results is also considered. M.W.R.

N67-26688# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ANALYSIS OF HUMAN OPERATOR PERFORMANCE

V. P. Zinchenko, N. I. Mayzel', A. I. Nazarov, and A. A. Tsvetkov *In its* Eng. Psychology 31 Oct. 1966 p 220–251 refs (See N67-26681 14-05)

The optimum organization of human operator performance is discussed in terms of the distribution of functions between man and machine, the interaction of individuals in control systems, human throughput capacity, and criteria and conditions with regard to accuracy and reliability. Analysis of operator performance is also considered in terms of the development of training and selection methods. State of reception and coding of information, other aspects of information processing, and various types of solutions used to determine performance are treated; and a tentative classification of human operator activity is proposed. M.W.R.

N67-26689# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PSYCHOLOGICAL CHARACTERISTICS OF HEARING

L. A. Chistovich *In its* Eng. Psychology 31 Oct. 1966 p 252–288 refs (See N67-26681 14-05)

The absolute sensitivity of hearing is discussed, and thresholds are considered for complex sounds and unpleasant sensations. Threshold and loudness are treated as functions of signal duration, and attention is given to differential intensity and frequency thresholds. Discrimination of the time structure of the signal is also discussed in terms of previously made studies. Studies dealing with the absolute recognition of sound signals are reviewed, as are those dealing with tonal masking. Auditory attention, its selectivity, and possible rate of switching are mentioned. M.W.R.

N67-26690# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME PSYCHOPHYSIOLOGICAL CHARACTERISTICS OF VISION

I. Ya. Grotov and G. N. Il'ina *In its* Eng. Psychology 31 Oct. 1966 p 289–343 refs (See N67-26681 14-05)

Soviet and other literature is reviewed for information on the parameters which characterize the visual system that must be considered in automatic perception systems. Parameters determining the visibility of objects are discussed, including angular size of the object, level of brightness adaptation, contrast between object and background, and shape of the object. An empirical formula is presented for the calculation of visibility parameters of objects, the temporal characteristics of visual perception are discussed, and eye movements of the observer and visual fatigue studies are reviewed. A discussion of so-called practical problems deals with observing both images on projection screens and signals in radar tubes. Illumination and brightness of screen and symbols, selection of colors for signals on a screen, and selection of rate of changing frames projected on the screen are treated. Some recommendations are offered for the design of calibration scales for instruments; and procedures for making studies are outlined. M.W.R.

N67-26691# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIENCE IN EXPERIMENTAL INVESTIGATION OF THE FUNCTIONING OF AN OBSERVER'S VISUAL SYSTEM

Yu. B. Gippenreyter *In its* Eng. Psychology 31 Oct. 1966 p 344–405a refs (See N67-26681 14-05)

A hypothetical model of certain aspects of the activity of an operator–observer is used to investigate functioning of the human visual system. Particular attention is given to the simultaneous reception and deposition of information along several channels or in several portions of the observer's visual field. Principal experimental method was the recording of ocular movements. Temporal parameters of detection and identification of an object in the visual field were investigated, and characteristics of visual system functioning while seeing uniform multiple objects were studied. For the latter, inherent oculomotor noise and fixation and scanning experiments are discussed. In the experiments, false alarms and

confusion due to blinking were noted. Also reported are certain parameters of the functioning of an operator's visual system during the reading of signals from large displays of figures. Recognition and the operative visual field is discussed. M.W.R.

N67-26692# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THEORETICAL PROBLEMS IN THE PSYCHOLOGY OF PERCEPTION

V. P. Zinchenko *In its* Eng. Psychology 31 Oct. 1966 p 406–466 refs (See N67-26681 14-05)

A genetic method is used to describe different levels of information transformation and to isolate individual perceptual operations. This method is considered particularly adequate for studies in bionics and engineering psychology, for which common logical simplifications are found to be ineffective. A discussion of criteria of perception concludes that each perceptual operation apparently has its own criteria for occurrence and productivity. Levels of perception are discussed in terms of the genetic approach, and natural methods for modeling stimuli are described, objective forms of modeling are noted, and sensory learning is discussed. Perceptual operations and actions are considered, as are recognitive actions and the probability approach to perception. M.W.R.

N67-26693# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEMS OF THE PSYCHOLOGY OF MEMORY AND INFORMATION THEORY

P. I. Zinchenko, P. B. Nevel'skiy, N. I. Ryzhova, and V. P. Sologub *In its* Eng. Psychology 31 Oct. 1966 p 467–524 refs (See N67-26681 14-05)

The concept of memory as a subjective activity is considered as the basis of a critical analysis of various approaches to information theory, and an overview of world literature is presented on the application of information theory to problems related to the psychology of memory. Spontaneous recall is considered, as is recall of lists of material and the encoding of information to increase the memory capacity. Organization of material and redundancy influences on memory are treated, and symmetry is considered as an aspect of redundancy. Pattern recognition and memorization of nonsense syllables are discussed, along with the role of grouping material to enhance the memory process. The perceptron and other memory machines are noted, along with their limitations. A comparison of Soviet and American potentials for applying information theory to the psychology of memory is made. M.W.R.

N67-26694# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFORMATION PROCESSING BY MAN IN THE CHOICE SITUATION

A. N. Leont'yev and Ye. P. Krinchik *In its* Eng. Psychology 31 Oct. 1966 p 525–580 refs (See N67-26681 14-05)

Human reaction time as a function of the amount of information received is studied in psychological experiments dealing with man's ability to process information. The Hicks and other models are discussed, and various numbers and kinds of stimuli are considered. Factors that influence the rate of information processing are noted; and a study is reported in which the difficulty in visual discrimination of the object leads to differences in the reaction time independent of entropy, under identical training conditions. Studies are reviewed in which the ratio of reaction time and amount of information is related to the factor called stimulus-response compatability; and the psychological characteristics of information processing by man are noted. The role of the significance of the signal, and its influence on reaction time and on information content is considered; and the factor of signal significance is considered to regularly organize the behavior of man. M.W.R.

N67-26695# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF SENSOMOTOR RESPONSES AND MOTOR HABITS

A. I. Nazarov *In its* Eng. Psychology 31 Oct. 1966 p 581–604 refs (See N67-26681 14-05)

Basic factors that affect the speed and accuracy of sensory motor responses are examined, and the mechanisms that regulate motor habits are considered. A simplified model is presented of a semiautomatic system controlled by manual movements of the operator, and a time-motion diagram is introduced to indicate the variables that influence the characteristics of the operators' movements. Speed of response reactions are considered in terms of the transmission time of impulses from the receptor to the central nervous system, and the time required for the organization of the response reactions. Psychological refractory phase is discussed as are the mechanisms of movement control. M.W.R.

N67-26696# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE "NOISE RESISTANCE" OF THE OPERATOR

F. D. Gorbov *In its* Eng. Psychology 31 Oct. 1966 p 605–637 refs (See N67-26681 14-05)

Healthy young flying personnel with approximately the same general and specialized training are shown to have different resistances to noise, and experience and training are shown to influence the noise resistance or noise suppression capacity of these human operators. Test subjects worked with a numerical table on which black and red figures were arranged in random combinations in 49 squares, and numbers in the various squares had to be read in specified orders. The action of noise stimuli on the operator assumed particular importance when the operator's activity was continuous and when there was a need for a steady current of information signals. M.W.R.

N67-26697# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RELIABILITY OF OPERATOR PERFORMANCE IN A COMPLEX CONTROL SYSTEM

V. D. Nebylitsyn *In its* Eng. Psychology 31 Oct. 1966 p 638–657 refs (See N67-26681 14-05)

Reliability and effectiveness of human operator performance in a semiautomatic complex control system is treated both qualitatively and quantitatively. Breakdowns or errors due to sleep, blackout, or other factors are considered; and various industrial reliability concepts are applied to the human operator. These include mean duration of work between breakdowns, total number of breakdowns, percentage of completed tasks, and probability of satisfactory performance for a given period of time. Factors determining human operator performance are discussed, including influence of maintenance personnel, degree of training, personal factors involving the cardiovascular and nervous system, and psychological factors. Long-term endurance, noise resistance, spontaneous distraction, reactions to unpredicted stimuli, switching ability, and resistance to environmental factors are discussed in terms of their influence on performance. M.W.R.

N67-26698# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ACCURACY OF OPERATOR PERFORMANCE AND ERROR CHARACTERISTICS

B. F. Lomov *In its* Eng. Psychology 31 Oct. 1966 p 658–680 refs (See N67-26681 14-05)

From a psychological point of view, the problem of accurate operator performance is considered as the formation of an adequate image of the controlled object or process and the corresponding controlled action that results. In order to predict the errors that man will make, it is therefore necessary to consider the role of the

object or process, the equipment, and the working conditions in controlling man's actions. The accuracy of the performance of a control system is dependent to a considerable degree on the operator. A general discussion of the control system, human errors and overall performance, and the man–machine system is included.
M.W.R.

N67-26699# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE PROBLEM OF THE STABILITY OF OPERATOR PERFORMANCE IN A CONTROL SYSTEM
M. M. Novoselov *In its* Eng. Psychology 31 Oct. 1966 p 681–691 refs (See N67-26691 14-05)

A method is proposed for determining the stability, or freedom from error, of human operator performance in a control system. While the method does not indicate concrete deficiencies in the equipment design, it does indicate the suitability of the design as a whole. The concept of breakdown of man–machine systems is considered, along with criteria of breakdown-producing operator function and psychophysiological aspects of operator performance. The empirical function of the stability of operator performance in the system is determined mathematically, as is breakdown probability.
M.W.R.

N67-26700# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PSYCHOLOGICAL PROBLEMS OF PERSONNEL SELECTION
N. I. Mayzel', V. D. Nebylitsyn, and B. M. Teplov *In its* Eng. Psychology 31 Oct. 1966 p 691–712 refs (See N67-26681 14-05)

Psychological and physical problems in the selection of aviation, military, and industrial personnel are discussed; and the need for precise knowledge of working conditions, the job to be done, and the available personnel is stressed. Both the trainability of the individual and his performance under real working conditions are considered. Personal attributes of the human operators, and means of compensating for weaknesses are also discussed in this general presentation.
M.W.R.

N67-26716# Monsanto Research Corp., Dayton, Ohio.
GAS-OFF STUDIES OF CABIN MATERIALS
F. N. Hodgson and John V. Pustinger, Jr. *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 14–23 ref (See N67-26714 14-04)
(Contract AF 33(615)-1779)

Two programs designed to establish the gas-off and possible oxidation products from individual cabin materials using bench-scale environmental simulators, are described. Materials such as partially fabricated spacecraft components and freshly prepared paints and coatings are being evaluated. The test atmospheres are analyzed by a variety of gas chromatographic and mass spectrometric methods. Types of compounds detected in the chamber atmospheres include: inorganics, alkanes, alkenes, hydroxy compounds, ethers, alkyl halides, carboxylic acids and their derivatives, aldehydes, ketones, aliphatic nitrogen compounds, benzene and its homologs, aryl halides, and silicon compounds. Results of analyses of gas-off products from an epoxy resin, adhesive material, phenolic resin, and carbon monoxide and methane; are tabulated. It is concluded that: (1) Qualitative identification of gas-off components is possible to the level of 0.1 ppm in the gaseous atmosphere; (2) Whenever possible, materials should be evaluated in their final form and under the conditions of use; (3) Pretreatment of candidate materials should simulate conditions encountered in use; (4) To provide quantitative data for meaningful comparison between testing laboratories, some standardizations of sample preparation (size, shape, exposed surface, etc.) should be made; and (5) Estimates of the amounts of gas-off components can be made from mass spectrometry and gas chromatography analyses; however at extremely low levels, considerable variation in measurements can arise.
S.C.W.

N67-26717# Aerojet-General Corp., Azusa, Calif.
TOXICOLOGICAL SCREENING OF SPACE CABIN MATERIAL
B. D. Culver *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 24–30 (See N67-26714 14-04)

Reported is the initiation of experiments designed to study toxicity of materials at reduced pressures under conditions similar to those found in space cabins. Presented are data on the design and construction of animal exposure chambers for Apollo toxicity screening tests. Preliminary studies of rats and mice are described. Conditions of exposure were 75°F ±5, 50% relative humidity ±10%, CO_2 concentration below 1/2%, and 5 psia total pressure. Animals were exposed for a week to each of four groups of materials which included: mixed groups of resins and mounting materials. Changes observed in animals exposed to mixed groups of resins included a slight loss of weight. Following the period of exposure, the animals were kept and observed for one week. It was found that these animals underwent a weight loss at a 0.01 level of statistical significance. Experiments are being planned to determine the biological significance of these findings. It is recommended that the analytical chemists be utilized in defining quantitatively atmospheric constituents, so that exposure systems can be designed to monitor classes of materials found in the atmosphere, and so that studies of the range of responses to total constituents in these various families or fractions can be initiated on a wider scale.
S.C.W.

N67-26718# School of Aerospace Medicine, Brooks AFB, Tex.
CONTAMINANT STUDIES IN CLOSED ECOLOGICAL SYSTEMS AT THE USAF SCHOOL OF AEROSPACE MEDICINE
James P. Conkle *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 31–52 refs (See N67-26714 14-04)

Presented are results of a 27-day experiment at 760 mm Hg (oxygen, 20%; nitrogen, 80%) which was conducted to define the contaminants associated with human occupancy of a sealed environmental simulator; and an experiment of 56 days duration which was performed to evaluate the stability of a helium (30%)–oxygen (70%) atmosphere at 258 mm Hg. Rapid, initial increases in the carbon monoxide concentration were observed in both studies. The methane concentration during the 27-day experiment increased from 20.9 mg/m^3 the day after men entered the chamber to a high of 84.6 mg/m^3. The 56-day experiment methane concentrations ranged from a low of 4.7 mg/m^3 to a high of 13.7 mg/m^3. No significant data relating to organic compounds were obtained from the analysis of unconcentrated samples during either experiment. Thirty-nine compounds were reported during the 27-day experiment which were not reported during the 56-day study. Seven components were reported during the 56-day study which had not been reported during the 27-day study. Fifty-eight compounds were reported for both experiments. The atmospheres to which four human subjects were exposed for 14 days at 760 mm Hg and 56 days at 258 mm Hg were analyzed for trace contaminants. A total of 105 compounds were detected. The concentration of these compounds remained below a level thought to cause a physiologic effect. Carbon monoxide and carbon dioxide were the only compounds which were produced by man at such a rate that clearly would require removal in long term sealed atmospheric habitation.
S.C.W.

N67-26719# Naval Research Lab., Washington, D. C.
A DANGEROUS CLOSED ATMOSPHERE TOXICANT, ITS SOURCE AND IDENTITY

Raymond A. Saunders *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 53–59 (See N67-26714 14-04)

Described is an incidence of organic contamination which was discovered during a Project MESA (Manned Environmental Systems Assessment) evaluation of a completely integrated and regenerative air, water, and biological life support system. The purpose of the evaluation was to determine the effectiveness of the system by maintaining five men in a completely closed system for 30 days. Symptoms after exposure to the MESA chamber atmosphere included a very distinct and sickening sour–sweet odor which became increasingly irritating to the crew; loss of appetite; nausea; itchiness around the eyes; headaches; sore gums; painful jaws; and severe cold sores. Of the various contaminants recovered from the MESA atmosphere, the most prevalent trace contaminant was trichloroethylene, which had been used in the chamber for cleaning purposes prior to the start of the manned test. The two uncommon compounds found were mono- and dichloroacetylene. Further studies indicated that dichloroacetylene was one contaminant in the MESA atmosphere which accounted for all of the rather unusual symptoms exhibited by the crew; and that its presence was attributable to the partial decomposition of its precursor, trichloroethylene, by the sodium superoxide unit. The MESA experiments document the first serious case of organic trace contamination in a confined environmental atmosphere which was serious enough to incapacitate a crew. The significance of these findings is that the causative agent was not a gas-off product from any cabin material, but a contaminant actually generated by the contaminant control system. S.C.W.

N67-26734# School of Aerospace Medicine, Brooks AFB, Tex.
RESUME OF MANNED EXPERIMENTS
Lexter J. Krasnogor and B. E. Welch *In* AMRL Proc. of the 2d Ann. Conf. on Atmospheric Contamination in Confined Spaces Dec. 1966 p 281–289 refs (See N67-26714 14-04)

Reviewed are studies conducted by the Environmental Systems Branch of the USAF School of Aerospace Medicine regarding the biomedical effects of potential space cabin environments. Discussed are studies pertinent to the issue of single versus mixed gas atmospheres for manned space flight. Atmospheric compositions studied consisted of either 100% oxygen; 70% oxygen and 30% helium; 44% oxygen and 56% helium; 40% oxygen and 60% nitrogen; and 33% oxygen and 67% nitrogen. Experiments were performed in two and four man space cabin simulators over a period of five years. All atmospheres tested were tolerated well enough so that the studies were all completed without major difficulties. Those studies involving oxygen at higher than normal alveolar tensions resulted in decreases in hematocrit which were not of enough magnitude to be a clinical problem over the span of the experiments but could conceivably become serious in a more prolonged exposure. The presence of an inert gas has certain real and theoretical advantages over the single gas atmosphere. There were no detectable differences between nitrogen and helium that would favor either gas from a biomedical viewpoint. The need for reevaluation and further research regarding the correlation of findings in animals with those in humans is amplified. S.C.W.

N67-26765# Carnegie Inst. of Tech., Pittsburgh, Pa. Management Sciences Research Group.
TOWARD THE DESIGN OF A GROUP: A PRELIMINARY MODEL
M. W. Shelly and A. C. Stedry (Kans. Univ.) Jan. 1967 28 p refs
(Contracts Nonr-760(24); N00014-66-C0173)
(RR-88; AD-648084) CFSTI: HC $3.00/MF $0.65

Concepts relevant to a theory of group design are presented. Criteria appropriate to evaluating group interaction are developed. A simple model of interaction within a group is presented. Using a linear programming formulation, the value of group interaction is maximized. The emphasis throughout is on interaction value as a function of the subjects discussed, the knowledgability of the speakers and the interests of the listeners. This, rather than the amount of action per se, is the focus of the current work and future plans discussed for expanding the model. Author (TAB)

N67-26760# Tracerlab., Waltham, Mass.
ANALYSIS OF SELECTED SAMPLES BY MICROWAVE SPECTROSCOPY FOR TRACE CONTAMINANTS COLLECTED FROM A SPACE SIMULATOR Final Report, Jun. 1965–Feb. 1966
Joris M. Brinkerhoff and Stanley M. Klainer Jan. 1967 13 p refs
(Contract AF 41(609)-2809)
(SAM-TR-67-3; AD-648132) CFSTI: HC $3.00/MF $0.65

Analyses of simulator atmosphere samples were attempted using microwave spectroscopy. The samples were obtained directly from the simulator and were not subject to any further treatment before analysis was attempted. The results indicated absence of microwave absorbing gases in concentrations ranging from approximately 5 to 5000 p.p.m. with the exception of water vapor. The direct sample technic for microwave analysis of the trace contaminant concentration in simulator atmospheres appears unfeasible with present technics and instrumentation of microwave spectroscopy. Author (TAB)

N67-26810# Naval Research Lab., Washington, D. C.
THE APPLICATION OF MAN-MACHINE SYSTEM EQUALIZATION TECHNIQUES IN THE DESIGN OF HEAD-UP DISPLAY Final Report
C. L. Tipton Jan. 1967 70 p refs
(NRL-MR-1740; AD-648301) CFSTI: HC $3.00/MF $0.65

A two-symbol head-up display design incorporating an optimal form of system equalizing feedback dynamics is conceived as feasible and adequate for the consistently accurate manual control of stereotyped flight profiles. The design provides a compound control symbol for the simultaneous display of stick, throttle and rudder commands. A general systems analysis (longitudinal plane) illustrates the utilization of this display design in the landing, take-off and weapon delivery modes of flight. The feasibility of this design concept is substantiated by the development of an analytical methodology which directly determines an optimal configuration of system equalizing feedback terms for a given higher order control loop. These feedback signals drive the operator's displayed control symbol such as to elicit manual control motions that effect an optimal system response in the cancellation of system error. This equalization methodology is exemplified in the determination of a full complement of implemented feedback terms for the optimal pitch control of a high performance fixed wing aircraft. General observations are made concerning the inclusion and influence of a human operator in an equalized control loop. Author (TAB)

N67-26912# RAND Corp., Santa Monica, Calif.
SOME ASPECTS OF MAN–COMPUTER COMMUNICATION IN ACTIVE MONITORING OF AUTOMATED CHECKOUT
Leonard Chesler and Rein Turn Mar. 1967 34 p refs Presented at the 4th Space Cong., Cocoa Beach, Fla., 3–6 Apr. 1967
(P-3522; AD-648553) CFSTI: HC $3.00/MF $0.65

Requirements for active participation by test personnel in monitoring automated checkout operations arise whenever hazardous conditions exist, tight time schedules must be met, and costs of failure are high. Under these circumstances the goals of a human monitor could be to maintain context with the progress of the checkout operations and to detect and react to malfunctions in checkout equipment, incorrect design or execution of the checkout programs, and unexpected events that the latter have not been designed to handle. The human monitors effectiveness in performing these tasks depends directly on what information is available to

him and how it is presented. Displays that use simple coding and formating to increase information extractability and that contain adequate anticipatory and alerting information may be essential for real-time interaction with automated checkout operations. As an example of extractable information presentation, a dynamic network display of checkout operations is discussed. Such a display permits a monitor to determine at a glance the status of the checkout process. The programming task for the display can be greatly eased by use of a digital computer equipped with graphic input devices.
Author (TAB)

N67-26934# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
AN ADVANCED LIFE-SUPPORT CAPSULE FOR THE CHIMPANZEE
Martin Reite, Loyd Stephens, and Oliver Lewis *In* School of Aerospace Med. Proc. of the 13th Ann. Conf. of Air Force Behavioral Scientists Sep. 1966 p 309–327 refs (See N67-26921 14-04)

Reported are the test results on an advanced life-support capsule for a chimpanzee. Information obtained from the EEG, behavioral, and physiological monitoring during an 8 day period showed that performance impairment and EEG abnormalities occurred prior to any abnormalities in other physiological measures; progressive behavioral impairment was clearly reflected in cortical EEG changes.
G.G.

N67-26966# Illinois Univ., Urbana. Group Effectiveness Research Lab.
INTERPERSONAL PERCEPTION AND PSYCHOLOGICAL ADJUSTMENT OF GROUP MEMBERS Annual Report
Fred E. Fiedler Mar. 1967 20 p refs
(Contract DA-49-193-MD-2060)
(AD-648741) CFSTI: HC $3.00/MF $0.65

This project investigates factors in the work situation which contribute to the personal adjustment and effective performance of military personnel. The projects particular concern is with the influence of the work group and the task situation on individual performance and adjustment. The project aims to develop principles and methods which will enable the military services to prevent and alleviate maladjustment by capitalizing on existing interpersonal relations in groups or by structuring the group and the task situation so as to promote these adjustive interpersonal relations.
TAB

N67-27004# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
ANALYTICAL GAS DESORPTION APPARATUS Final Report, Jul. 1964–Mar. 1965
W. H. Toliver, Sr., R. E. Bennett, and C. G. Roach Nov. 1966 17 p refs
(AMRL-TR-65-61; AD-648516) CFSTI: HC $3.00/MF $0.65

Volatile organic contaminants are a problem in spacecraft, evaluators, and other closed cabin atmospheres and must constantly be measured. Consequently, a chemical high vacuum system for the desorption and manipulation of desorbates from solid adsorbents was developed. Essentially, the system is provided with three provisions for trapping the contaminant depending on its volatility. The high boilers are trapped in the first section, the compounds with low vapor pressure are collected in the middle section, and the noncondensables in the third section of the apparatus.
Author (TAB)

N67-27014# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
VISUAL FACTORS AFFECTING THE PRECISION OF COORDINATE MEASUREMENT IN AEROTRIANGULATION
Desmond C. O'Connor 13 Jan. 1967 186 p refs
(GIMRADA-RN-21; AD-648303) CFSTI: HC $3.00/MF $0.65

A study was made of the precision of centering black circular measuring marks in sharp circular targets simulating artificial pass-points with homogeneous backgrounds of different densities. An extensive review of the relevant functions of the visual system is given, and the task is related to the general area of visual acuity. The results demonstrate that the precision of pointing may be significantly affected by the size relationship between the measuring mark and pass-point, the background density, and the adaptation level, provided that the instruments used are sufficiently sensitive. The results support the proposition that subjective neural effects at edges contain significant visual information, and this would appear to be important where visual settings are being made by bringing geometrical configurations into close relationship with one another. The maximum information for the centering was contained in ribbons approximately 1 minute of arc wide around the light areas of target and measuring mark. The most precise pointings were made by selecting a measuring mark to give a minimum annulus width within these ribbons, irrespective of the target size, up to 2 degrees retinal subtense. The relationship between the standard deviation of pointing and annulus width appears to be linear for annulus widths up to approximately 1 minute of arc visual subtense. A discontinuity occurs in this vicinity, and the relationship appears to take on an exponential form.
Author (TAB)

N67-27057# Clark (David) Co., Inc., Worcester, Mass.
RESEARCH AND DEVELOPMENT OF EXTRAVEHICULAR PROTECTIVE ASSEMBLY Final Technical Report, 2 Jul. 1962–30 Apr. 1964
Norman H. Osborne and Lee C. Rock (AMRL) Oct. 1966 73 p refs
(Contract AF 33(657)-9532)
(AMRL-TR-66-143; AD-647197) CFSTI: HC $3.00/MF $0.65

A prototype extravehicular pressure suit assembly was designed and fabricated for use in earth and lunar environments. Conditions of space environment, preliminary design concepts, laboratory evaluations of materials, the intermediate model configuration, and the final suit assembly are described in detail. This assembly consists of special underwear, linear ventilation system, gas container, restraint layer and cover, insulation, micrometeorite protection, and outer reflective layer, and a life support system. The life support system is a liquid oxygen, semiclosed, recirculating-type backpack. The use of new material distinguishes this assembly from current pressure suits. Recommendations for further research and development are included.
Author (TAB)

N67-27102*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
LINGUISTICS
In its Res. Lab. of Electron. 15 Apr. 1967 p 279–303 refs (See N67-27081 14-23)
(Contracts AF 19(628)-2487; DA-28-043-AMC-02536(E); Grants NSF GK-835; NIG G-MH-04737-06)

Communication science and engineering research in the field of linguistics is reported. Language concepts are discussed in the following areas: noncyclic transformational grammars, Lithuanian morphophonemics, English inward-and-upward directionals, and the concept of performance.
R.U.

N67-27104*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
NEUROPHYSIOLOGY
In its Res. Lab. of Electron. 15 Apr. 1967 p 321–327 refs (See N67-27081 14-23)
(Contracts NSR-22-009-138; AF 33(615)-3885; Grant NIH NB-04985-04)

Neurophysiological research is reported on contrast detectors and the problem of insight into neuronal closed loops from shift-register theory. Consideration is given to the dependence of

ganglion tone upon the length of the contrast, or edge, of the retinal image and upon its velocity. By applying a process used to model a specific visual ganglion cell, an expression is obtained for such a dependence. This process is the lateral (nonlinear) inhibition at the level of the ganglion cell dendrites. Within the scope of nerve net theory, concepts of shift registers have been formulated. Technical details are completed by a logic gate schematic of a nonlinear feedback shift register for control and command. R.Li.

N67-27189# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

HUMAN FACTORS EVALUATION OF A LARGE SCREEN RADAR DISPLAY Final Report

Lee E. Paul and Edward P. Buckley Mar. 1967 31 p refs

(RD-66-105)

A Controller Decision Evaluation (CODE) experiment was performed to compare a 20-inch horizontal individual display with an 8 by 10 foot Eidophor projected group display in the terminal environment. Sixteen subjects used each display for four 90-minute sessions. No significant differences between displays were found in either the number of conflictions missed or the number of unnecessary control actions taken. It was concluded that there is nothing inherent in the large common display that would preclude it from use as an air traffic control display. A discussion of a number of factors should be considered in such a use is given. Author

N67-27233*# Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.

PERFORMANCE AND THERMAL RESPONSE OF THE GEMINI EXTRAVEHICULAR SPACE SUIT—EXPERIMENT I-b

R. O. Pearson, T. E. Mouritsen, and F. H. Goodnight 23 Dec. 1964 231 p

(Contract NAS9-3414)

(NASA-CR-65617; Rept.-00.573) CFSTI: HC $3.00/MF $0.65 CSCL 06K

Main objective of the test series was to determine the design adequacy for operation in an extravehicular earth orbit. The prototype suit was instrumented for temperature and pressure measurements and was tested in a simulated 200-nautical-mile earth orbit. A thermal dummy capable of providing the sensible heat of a man was placed into the suit assembly. Testing was conducted over a three-day period under the following conditions: (1) cold soak with −320°F walls; (2) earth orbit simulation; (3) contact with heated spacecraft surface; and (4) high solar heat inputs. Specific measurements, simulation methods, and construction of the suit are described. Suit pressures ranged from 3.8 to 4.4 psia, gas leakage varied between 140 and 190 scc/min. The temperature of the outer surface of the suit did not exceed +200°F or fall below −200°F during the tests. Test performance of the suit was in general within acceptable limits. K.W.

N67-27266*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN EXPERIMENTAL INVESTIGATION OF TWO VISUAL METHODS OF ALTITUDE DETERMINATION

Jacob H. Lichtenstein and William T. Suit Washington, NASA, May 1967 30 p refs

(NASA-TM-X-1392) CFSTI: HC $3.00/MF $0.65 CSCL 05H

An investigation was made to measure the ability of an astronaut to determine the altitude of his spacecraft above the lunar surface by purely visual means. Two techniques were used: one consisted of matching calibrated curved arcs to the projected horizon curvature, and the other consisted of measuring the visual arc subtended by a known surface feature. The slides used for projection were photographs of a relief map of the lunar surface. A second set of slides with a smooth arc for the horizon was used in order to evaluate the effect of horizon irregularity. For the limited field of view used (about 40°) in the horizon-arc matching technique, the average errors for these measurements were as large as 36 miles (58 km) and the standard deviation was about 28 miles (45 km). Repeating the slides a second time or using the smooth-arc slides decreased the error but did not seriously affect the standard deviation. The results indicate that a learning process is involved and that features on the horizon do influence the altitude estimations. The surface-feature technique, when the surface feature was viewed from directly above, seemed to be considerably more accurate for determining altitude than the horizon-matching technique. Author

N67-27380# Joint Publications Research Service, Washington, D. C.

OPTIMAL TRAINING ALGORITHMS FOR AUTOMATIC SYSTEMS IN THE CASE OF A NONIDEAL TEACHER

V. S. Pugachev 17 Apr. 1967 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 172, no. 5, 1967 p 1039–1402

(JPRS-40659; TT-67-31303) CFSTI: HC $3.00

Using the Bayes approach, formulas are developed for the posteriori probability density of the random vector and the optimal estimates of the decision function with respect to the criterion of least mean square error. The nonideal training conditions are identified as those in which it is impossible to put into the system absolutely accurate values of the required output signal, and only statistical estimates are used. The formulas define the general Bayes optimal training algorithm for an automatic system which does not depend on how the information input to the system is used in the training process. N.E.N.

N67-27507 Kansas State Univ., Manhattan. Dept. of Psychology.

ANALYTIC STUDIES IN THE LEARNING AND MEMORY OF SKILLED PERFORMANCE Semiannual Report, Oct. 1, 1966–Mar. 31, 1967

Merrill E. Noble and Don A. Trumbo 24 Apr. 1967 18 p

(Grant NsG-606)

(NASA-CR-84473) CFSTI: HC $3.00 CSCL 05J

Several pilot studies and a completed study involving dual motor tasks are described. Previous experiments involving a primary tracking task and a secondary verbal task had indicated intertask interference in the dual task situations which appeared to be a function of the decision making requirements of the second task when an overt verbal response was required. The present studies were conducted to determine whether the same generalizations about human dual task performance would hold when the second task was another motor, and to evaluate the effects of the temporal phasing of the inputs from the two tasks on the degree of primary task interference. The results indicate that the response requirements of the secondary task were a significant source of variance in tracking performance scores, but that no significant effects could be attributed to the phase relations between the two tasks. Another study is described which compares response strategies when the higher of two probabilities was the same in two alternative situations. Some partial results are discussed. R.N.A.

N67-27558# Beaver Coll., Glenside, Pa.

LEADERSHIP STATUS AS A MODULATOR OF THE DETERMINATION OF SOCIAL INTERACTION BY PRIOR REINFORCEMENT

Bernard Mausner, Ellen Lederman, and Shirley Katz 1966 31 p refs

(Contract Nonr(G)-00028-66)

(TR-2; AD-648449) CFSTI: HC $3.00/MF $0.65

An experiment was designed to test the influence of prior experience of campus leadership as a modulating factor in the

effect of prior reinforcement of judgmental responses on behavior in a social interaction in judgment. Twenty female college students were run; ten were leaders and ten were non-leaders. Judgments were made of the rate of alternation of a flickering light. Half of each group were told they were right 17 out of 21 trials; half of each group were told they were wrong on an equivalent number of trials. Ss were then run in apparent communication with each other, actually receiving false information that Ps judgments were 25 per cent higher. Among the leaders the reinforcement schedule determined tendency to shift judgments towards P; Ss told they were wrong shifted and those told they were right maintained. Among the non-leaders there was no demonstrable effect from the reinforcement schedule. However, the degree to which the experiment was perceived as a test of individual skills or as a social situation did determine degree of shift in judgment. Interaction effects on analysis of variance were significant for leader vs. non-leaders, positive vs. negative reinforcement. Thus, leaders are found to respond to cues in the outside world, non-leaders to internal mediating systems. Author (TAB)

N67-27571*# Atlantic Research Corp., Alexandria, Va.
ENVIRONMENTAL TESTING OF CONTAMINANT PRODUCING MATERIALS FROM THE INTEGRATED LIFE SUPPORT SYSTEM
W. S. Hodgkiss, Richard H. Johns, and James S. Swinehart Washington, NASA, Jun. 1967 103 p
(Contract NAS1-4425)
(NASA-CR-794) CFSTI: HC $3.00 CSCL 06K

An experimental investigation has been made of the existing and potential airborne trace contamination composition within the Integrated Life Support Systems (ILSS) test chamber located at Langley Research Center. Selected materials from the ILSS were examined as probable sources of contamination under specific time and temperature conditions to determine their characteristic products of gaseous evolvement. Contaminated air samples were collected as both "whole air" samples and cryogenically trapped samples. Primary compound identifications were made by gas chromatography with verification by mass spectrometry and infrared spectrophotometry. Physical and chemical changes in the materials due to heat effects were examined by weight changes and differential thermal analyses. Author

N67-27773# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
INFORMATION PROCESSING IN THE FUNCTIONAL VISUAL FIELD [INFORMATIEVERWERKING IN HET FUNKTIONEEL GEZICHTSVELD]
A. F. Sanders [1967] 16 p refs In DUTCH; ENGLISH summary
(IZF-1967-6; TDCK-47866) CFSTI: HC $3.00/MF $0.65

It was found that performance in a number of visual tasks does not linearly decline as a function of visual angle. Instead, there are stepwise drops at two visual angles, which prove to be the boundaries of the areas where inspection by means of peripheral vision and eye movements are sufficient to obtain optimal performance. The drops are explained in terms of strategies in processing visual information, which are thought to vary from grouping signals at small visual angles to successive handling at very large angles. This theory is reevaluated in the light of more recent notions on visual coding and recoding. The relation between grouping and perceptual organization is especially considered. It is concluded that earlier reported work is restricted to the macrostructure of the functional visual field. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N67-28488# Israel Inst. of Tech., Haifa. Dept. of Physics.
QUANTITATIVE HIGH TEMPERATURE INFRARED SPECTROSCOPY Final Scientific Report, 1 May 1965–31 Oct. 1966
U. P. Oppenheim 31 Oct. 1966 6 p refs
(Grant AF-EOAR-65-84)
(AFOSR-67-0612; AD-648664) CFSTI: HC $3.00/MF $0.65

The statistical band model was successfully applied to the NO fundamental band at 5.3 microns. The temperature range was 300-800K. Pressures between 0 and 5 atm were applied. The temperature dependence of the band model parameters was established and compared to existing theoretical results. Good agreement was obtained in the temperature range studied. Author (TAB)

N67-26596*# National Aeronautics and Space Administration, Washington, D. C.
CHANGES IN THE KINETIC PROPERTIES OF THE THERMAL DECOMPOSITION OF $KMnO_4$ AS A RESULT OF Co^{60} IRRADIATION [OB IZMENENII KINETICHESKIKH KHARAKTERISTIK TERMICHESKOGO RAZLOZHENIYA $KMnO_4$ V REZUL'TATE DEYSTVIYA IZLUCHENIYA Co^{60}]
V. A. Protaschik and B. V. Yerofeyev May 1967 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 10, no. 9, 1966 p 658–661
(NASA-TT-F-481) CFSTI: HC $3.00/MF $0.65

Quantitative aspects of changes in the kinetic behavior of the thermal composition of alkali metal permanganates, specifically $KMnO_4$, under irradiation by Co^{60} are discussed, with consideration of the influence of biographic factors such as dispersion, surface area, impurities, fabrication flaws, etc. The effect of irradiation on the kinetics of thermal decomposition consists mainly in an increase of the constant k in the topokinetic equation $\alpha = 1 - \exp(-kt^n)$, meaning that this effect primarily leads to the development of new potential centers representing foci for growth of solid product nuclei. Author

N67-26604# Illinois Univ., Urbana. Coll. of Engineering.
CHEMICAL ENGINEERING
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 33–38 refs
(See N67-26601 14-32)

Principles of physics, mathematics, and chemistry are used as a basis for extending and interpreting the experimental results reported in chemical engineering. Fields of current research interest include: solid state physics, heat transfer, mass transfer, fluid mechanics, kinetics, high pressure studies, nucleation phenomena, electro-organic chemistry, interfacial phenomena, process dynamics, reactor design, and thermodynamics. R.U.

N67-26628*# Rocketdyne, Canoga Park, Calif.
PROPERTIES OF NONAQUEOUS ELECTROLYTES Quarterly Report, 20 Dec. 1966–19 Mar. 1967
Rudolf Keller, James N. Foster, John F. Hon, and Jack M. Sullivan 19 Apr. 1967 90 p refs
(Contract NAS3-8521)
(NASA-CR-72065; R-6754-3; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 07C

A complete vapor phase chromatographic analysis of acetonitrile was conducted. A method was established for the routine characterization of purified solvent batches of propylene carbonate, dimethyl formamide and acetonitrile; the water content of each solvent is determined quantitatively to ±5 to 10 ppm. Structural studies of electrolytes containing tetramethylammonium hexafluorophosphate, tetramethylammonium fluoride, and $AlCl_3$ were performed by nuclear magnetic resonance. The physical property studies included measurements of viscosities, conductances, transference numbers, and solubilities of a number of electrolytes. Author

N67-26659# Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center.

HIGH ENERGY SYSTEM (ORGANIC ELECTROLYTE) Quarterly Report, 15 Sep.–15 Dec. 1966

H. R. Buhner and V. J. Spera Feb. 1967 48 p refs

(Contract DA-28-043-AMC-02304(E))

(QR-2; Rept.-6; ECOM-02304-2; AD-648920) CFSTI: HC $3.00/MF $0.65

Several new electrolyte solvents were evaluated in an attempt to obtain a solution with properties superior to those of LiC104/propylene carbonate. Although high specific conductivities, greater than 0.01/ohm/cm, were obtained in a few instances, LiC104/lactonitrile and LiC104/1, 3, Dioxolane, these electrolytes were very corrosive toward lithium. A new technique was used to prepare highly purified and anhydrous LiC104, by recrystallization from water and refluxing in ether. This process is based on the highly preferential solubility of anhydrous, as compared to hydrated, LiC104 in diethyl ether. Storage of CuF2 cathodes in electrolyte was found to result in more than a 50% loss in discharge efficiency after only two weeks storage. Complexones were re-evaluated, at low concentrations, in highly purified electrolyte, to determine the effect on CuF2 cathode performance. They were found to adversely affect the efficiency causing a 30-50% loss in performance with as little as 0.15% complexone. Silver II oxide cathodes were discharged at current densities between 2 and 8 ma/cm2 in LiC104/dimethyl sulfite and LiC104/dimethyl carbonate solutions. Energy density was found to decrease about 50% as current density increased over the range tested. TAB

N67-26665# Michigan Univ., Ann Arbor. Dept. of Geology and Mineralogy.

STUDY OF POLYTYPIC PHASE RELATIONS AMONG COMPLEX INORGANIC STRUCTURES Semiannual Report, 1 May–30 Oct. 1966

Donald R. Peacor Ft. Monmouth, N. J., Army Electron. Command Jan. 1967 13 p refs

(Contract DA-28-043-AMC-01338(E))

(Rept.-07325-3-T; Rept.-3; ECOM-01338-3; AD-648433) CFSTI: HC $3.00/MF $0.65

The determination of the crystal structure of senaite has progressed to the point where a trial model consisting of all atoms has been defined. Plumboferrite has been examined and found to have the magnetoplumbite substructure. The structure of CoGeO3 has been refined in detail and the occurrence of polytypism in this compound is readily explained by the approximation to closest packing. Crystals of hogbomite, senaite, hibonite, and crichtonite from additional localities have been examined. Author (TAB)

N67-26668# Coating and Chemical Lab., Aberdeen Proving Ground, Md.

STUDY OF SOLUBILITY OF TERNARY MIXTURES OF WATER/3-METHOXYBUTANOL 1/SODIUM TETRABORATE-DIOL CONDENSATES Interim Report

Charles B. Jordan Jan 1967 17 p refs

(CCL-222; AD-648701) CFSTI: HC $3.00/MF $0.65

The object of the study was to investigate the solubility phenomenon of ternary mixtures of water/3-methoxy butanol-1/sodium tetraborate-diol condensates as applied to hydraulic brake fluids. The effect of molar composition upon this phenomenon was studied. In some concentration ranges homogeneity or heterogeneity depended upon the order of addition of the three components. Solubility data was developed and curves were constructed illustrating the solvent/solute relationship. Possible explanation of the unusual findings were theorized and supporting evidence obtained and presented. Results elucidate some instances of previously unexplained appearance of sediment in stored hydraulic brake fluids. Author (TAB)

N67-26738# Western Reserve Univ., Cleveland, Ohio. Electrochemistry Research Lab.

DIFFUSION AND KINETIC CONTROL IN THE DISCHARGE OF HYDROGEN ON PLATINUM AND PLATINUM ALLOYS

Frank Ludwig, Ernest Yeager, and Gerald Lozier 15 Sep. 1966 15 p refs Presented at the Intern. Congr. of Polarography, Kyoto, Japan, 14–17 Sep. 1966

(Contract Nonr-2391(00))

(TR-21; AD-648830) CFSTI: HC $3.00/MF $0.65

Hydrogen discharge from acid solutions on bright platinum is characterized by a Tafel slope of -0.03 V/decade with an apparent limiting current or transition to a much higher slope at high current densities (>100 mA/sq cm). Similar measurements on gold-platinum alloys indicate that the Tafel slope and apparent exchange current are surprisingly independent of composition for alloys containing less than 0.8 atom fraction gold. For such alloys the apparent limiting current density was found to decrease with increasing gold content. Polarization studies with the rotating disc technique show that the current at constant potential is strongly dependent on rotation rate but reveal no significant dependence of Tafel slope on rotation rate. These results provide evidence that diffusion control involving dissolved H2 is predominant in the region of the -0.03 V/decade slope with kinetic control predominant only above this region. Further evidence of substantial super-saturation of the solution adjacent to the electrode with H2 was obtained with the rotating disc-ring technique. Author (TAB)

N67-26809# Midwest Research Inst., Kansas City, Mo.

MOLECULAR BEAM SAMPLING OF UNSTABLE SPECIES FROM HIGH PRESSURE SYSTEMS Summary Technical Report

Frank T. Greene and Thomas A. Milne 1 Feb. 1967 20 p refs

(Contract Nonr-3599(00))

(AD-646935) CFSTI: HC $3.00/MF $0.65

A technique has been developed for the mass spectrometric sampling of high temperature systems at atmospheric pressure and above. The gases to be sampled are expanded as a free jet, which is collimated into a molecular beam and introduced into the ion source of a mass spectrometer. Corrections must be made for two phenomena, mass separation and nucleation, which may accompany this sampling process. It has been possible to quantitatively sample stable products and free radicals from atmospheric and low pressure flames using a water-cooled probe. Condensible species have also been sampled using a probe in thermal equilibrium with the gas. It has not, however, been possible to sample with a cold probe species which form refractory condensed phases. These negative results with condensible species are attributed to interactions of the probe with the gas prior to the expansion. Author (TAB)

N67-26825# Oak Ridge National Lab., Tenn.

X-RAY DIFFRACTION DATA ON LIQUID CARBON TETRACHLORIDE AT 25°C

M. D. Danford, A. H. Narten, and H. A. Levy Feb. 1967 25 p refs

(Contract W-7405-ENG-26)

(ORNL-4068) CFSTI: HC $3.00/MF $0.65

The scattering of X-rays from the free surface of liquid carbon tetrachloride at 25°C was measured and analyzed. The diffractometer used was specially designed for the study of liquid samples. Both the raw data and the intensity and radial distribution functions derived from them are presented in tabulated form. The experimental radial distribution function is in essential agreement with previously published work on carbon tetrachloride, showing, however, much higher resolution. Intramolecular distances derived from the diffraction data are in excellent agreement with those obtained from gas scattering experiments. Author (NSA)

N67-26828# Los Alamos Scientific Lab., N. Mex.
SEALED-TUBE DISSOLUTION METHOD WITH APPLICATIONS TO PLUTONIUM-CONTAINING MATERIALS
Charles F. Metz and Glenn R. Waterbury 30 Nov. 1966 20 p refs
(Contract W-7405-ENG-36)
(LA-3554) CFSTI: HC $3.00/MF $0.65

Experience with a previously known technique for dissolving highly refractory materials is described. The technique was found to have wide application. It consisted of sealing the sample with HCl and an oxidant in a heavy-walled SiO_2 tube and heating to a suitable temperature, usually between 100 and 350°C. The sealed SiO_2 tube is placed in a steel shell to which solid CO_2 is added to compensate for the high internal pressure generated in the tube. Application of this dissolution method to refractory Pu containing materials is described in detail. Author (NSA)

N67-26830# Sandia Corp., Albuquerque, N. Mex. Fused Salts Information Center.
PHYSICAL PROPERTIES OF FUSED SALT MIXTURES. VOLUME 2: EUTECTIC COMPOSITIONS AND MELTING POINTS
Paul A. Clark 15 Nov. 1966 236 p refs
(Contract AT(29-1)-789)
(SC-R-65-930, Vol. 2) CFSTI: HC $3.00/MF $0.65

Data on eutectic compositions and melting points of fused salt mixtures are tabulated in two complementary tables arranged according to fused salt systems and melting points. Approximately 2700 references are given to literature data for the period 1907 through June 30, 1965. A cumulative coordinated index for vols. I and II is included. NSA

N67-26840# Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
CHEMICAL AND PROCESS DEVELOPMENT BRANCH Annual Report, Fiscal Year 1966
J. R. Bower, ed. Oct. 1966 114 p refs
(Contract AT(10-1)-205)
(IDO-14680) CFSTI: HC $3.00/MF $0.65

Aluminum- and zirconium-based fuels were processed. Uranium recovery from the aluminum fuel process was satisfactory, even though unusual surfactancy of the feed solutions caused some processing difficulties. The versatility of the semi-continuous, boron-poisoned, hydrofluoric acid process for zirconium-based fuels was amply demonstrated by the successful processing of standard PWR-type fuels, zirconium fuels containing stainless steel pins, and aluminum cans filled with zirconium scrap. Approximately 1.1 kg of ^{237}Np were recovered during routine processing of aluminum and zirconium fuels. Boron carbide in ATR fuel was shown to promote emulsion formation under extraction column conditions; boiling with gelatin appeared to alleviate the problem. Hydrogen formation during charging of zirconium fuel to a dissolver was found to be significant if the boric acid (6.3 g/l) solution in the dissolver (at 20°C) contained 0.003 *M* or greater hydrofluoric acid residue. The recovery of uranium from zirconium-fuel dissolver heels was hampered by the presence of stainless steel in the residue. Sulfuric acid was effective in releasing the uranium, which was not dissolved by the usual chromic acid reagent while stainless steel was present. Corrosion effects on the Monel dissolver are reported for the cleanout reagents. Recovery of uranium from EBR-II scrap resulting from the pyrometallurgical process was shown to be practical by use of a nitric acid dissolution process. Recovery of uranium from a melted LOFT reactor core (uranium dioxide partly fused with Zircaloy-4) appears to be possible by use of alternate nitric acid and hydrofluoric acid dissolution steps in a Carpenter-20 vessel. Uranium dioxide–zirconium dioxide fuel clad in Zircaloy-4 was completely dissolved in a three-step aqueous process using varying concentrations of hydrofluoric acid for decladding and core dissolution and chromic acid for uranium recovery. Calcium oxide in the core slowed the dissolution process, but the rate of corrosion on the Monel dissolver may offer the greatest drawback to the process. Author (NSA)

N67-26872# Little (Arthur D.), Inc., Cambridge, Mass.
THE ELECTRICAL CONDUCTIVITY OF AQUEOUS 0.03 TO 4.0M KCl SOLUTIONS UNDER HYDROSTATIC PRESSURE
R. A. Horne and R. P. Young 10 Mar. 1967 50 p refs
(Contract Nonr-4424(00))
(TR-27; AD-648529) CFSTI: HC $3.00/MF $0.65

The electrical conductivity of aqueous KCl solutions has been measured over the concentration range 0.03 to 4.0M, the temperature range −8 to +20C, and at pressures up to 4,000 kg/sq. cm. The effect of these variables on conductivity are similar to their effect on viscosity—generally speaking they all tend to destroy the regions of structure in water and cause water to behave more like a 'normal' liquid. Inasmuch as their effects are similar, the operancy of one variable tends to diminish the relative effectiveness of a second. Thus increasing the temperature or adding electrolyte tends to smear out the anomalous minimum in the pressure-dependence of the relative conductance. Author (TAB)

N67-26891# Hughes Research Labs., Malibu, Calif. Chemical Physics Dept.
ACID-BASE CHARACTERISTICS OF PHOTOCHROMISM Contract Report, 1 Oct. 1964–30 Sep. 1966
J. David Margerum [1966] 75 p refs
(Contract AF 49(638)-1264)
(AFOSR-67-0614; AD-647914) CFSTI: HC $3.00/MF $0.65

The mechanisms of photochromic reactions are studied in regard to their acid-base characteristics. An intramolecular mechanism, consisting of a six-membered hydrogen transfer from the methylene group in p-nitrobenzyl structures to an o-carboxylate group, is elaborated by kinetic analysis of the flash photolysis intermediates from 2-(4-nitrobenzyl)benzoic acid and other additional model structures. Compounds synthesized for this purpose include 5-nitro-o-toluic acid and 4,4-dinitrobibenzyl-2,2-dicarboxylic acid. The spectra of similar short lived aci-anion intermediates are observed in the photodecarboxylation of o- and p-nitrophenylacetic acid derivatives in aqueous base. These are identified by comparison with similar spectra obtained from other reactions of the corresponding nitrotoluene compounds. A ketone model compound, 2-methyl-5-nitrobenzophenone, was synthesized and unexpectedly found to cause efficient oxidation of isopropyl alcohol to acetone, as well as showing several spectral intermediates. The trans to cis photoisomerization of N, N-dimethylindigo and N, N-dimethyl-5, 5, 7, 7-tetrabromoindigo is confirmed, and the cis spectra of these two dyes are calculated using photostationary state techniques. The reverse cis to trans reaction kinetics are studied with flash photolysis and found to be highly acid-catalyzed. The reaction rate is linearly dependent upon the hydrogen ion concentration. Optical saturation effects with helium-neon and with ruby lasers are described. Author (TAB)

N67-26974# Tyco Labs., Inc., Waltham, Mass.
ELECTROCHEMICAL OXIDATION OF SATURATED HYDROCARBONS Final Technical Report
J. Giner and J. M. Parry Jan. 1967 108 p refs
(Contract DA-44-009-AMC-410(T))
(AD-648727) CFSTI: HC $3.00/MF $0.65

A study was undertaken to define and analyze the factors controlling the catalytic activity of platinum black toward the anodic oxidation of saturated hydrocarbons. The objective was to develop a correlation between the physical characteristics of a black, which should be a function of the preparation technique, and its electrochemical activity. The pattern of the work was as follows: (1) the preparation of many samples of platinum black over a wide range of carefully controlled conditions; (2) the characterization of the black; (3) the preparation of a practical electrode structure;

(4) electrochemical activity testing: ((a) over-all activity (steady state measurement), (b) intrinsic activity (transient measurement)). TAB

N67-26996 Technische Hochschule Munchen (West Germany). Institut fuer Radiochemie.
FORMATION OF LABELLED COMPOUNDS UNDER NEUTRON IRRADIATION [NEUBILDUNG MARKIERTER MOLEKUELE BEI DER URANSPALTUNG]
J. H. Born Brussels, EURATOM, Mar. 1967 18 p In GERMAN; ENGLISH summary
(Contract EURATOM-070-64-6 RISD)
(EUR-3282.d)

Experiments involving the neutron irradiation of benzene chromium tricarbonyl are reported. The results show that chromium hexacarbonyl is formed as the preferential reaction product after the (n,γ) process. The dependence of the reaction product yields on the irradiation temperature and on annealing was determined. Discussion of the data thus obtained revealed clearly that not free chromium atoms, but rather chromium atoms containing carbonyl groups, are mainly formed during the primary reaction, thus impeding the formation of dibenzene chromium. Author

N67-27000 Commissariat a l'Energie Atomique, Saclay (France). Departement des Radioelements.
RECOVERY OF RARE EARTHS AND STRONTIUM FROM ACID SOLUTIONS OF FISSION PRODUCTS BY MEANS OF ORGANOPHOSPHORUS DERIVATIVES [RECUPERATION DES TERRES RARES ET DU STRONTIUM DES SOLUTIONS ACIDS DE PRODUITS DE FISSION A L'AIDE DE DERIVES ORGANOPHOSPHORES]
G. Galaud Brussels, EURATOM, 1967 20 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-025-62-10 RISF)
(EUR-3277.f)

Some organophosphorus compounds of the phosphonate and phosphine–oxide type have been studied by liquid–liquid extraction techniques and separation chromatography on a porous solid impregnated with extractant. Author

N67-27020# United Nuclear Corp., White Plains, N. Y. Research and Engineering Center.
REMOVAL OF OXYGEN FROM SODIUM Final Report, Dec. 21, 1964–Feb. 14, 1966
John M. McKee Apr. 1966 63 p refs
(Contract AF 33(615)-2338)
(UNC-5143; AFAPL-TR-66-27; AD-648248) CFSTI: HC $3.00/MF $0.65

Anodic electrolysis of oxide-coated gettering alloys in sodium was evaluated as means of increasing their oxygen removal rate. Twenty-two zirconium and thorium base alloys were tested in sodium thermal convection loops. Detectable increases in gettering rate were observed for unalloyed zirconium and a few other alloys which formed adherent, dense, black films. The gains were not large enough to warrant practical application, apparently due to electronic short circuiting through small film defects. Some of the alloys which formed nonadherent, porous white films achieved higher removal rates than had been hoped for from electrolysis. Zr-13a/o Ti was the best of these. This alloy produced an oxygen content of less than 1 ppm in sodium and maintained significantly higher removal rates than pure zirconium at all temperatures and oxygen levels. Author (TAB)

N67-27072# Washington Univ., Seattle.
THE SYSTEMS XENON HEXAFLUORIDE–GERMANIUM TETRAFLUORIDE AND XENON HEXAFLUORIDE–SILICON TETRAFLUORIDE
Kent E. Pullen and George H. Cady 1967 17 p ref
(Contract N00014-67-A-0103-0002)
(TR-60; AD-647959) CFSTI: HC $3.00/MF $0.65

Xenon hexafluoride and germanium tetrafluoride, when mixed in the proper proportions, produce the compounds 4XEF6-GEF4, 2XEF6-GEF4 and XEF6-GEF4. Xenon hexafluoride appears not to react with silicon tetrafluoride. Author (TAB)

N67-27076# Rutgers Univ., New Brunswick, N. J. School of Chemistry.
THE ROLE OF SURFACE BORON AS ADSORPTION CENTER FOR THE SORPTION OF WATER BY POROUS GLASS
M. J. D. Low and N. Ramasubramanian 10 Mar. 1967 20 p refs
(Contract Nonr-404(19); Grant NSF GP-1434)
(TR-6; AD-648232) CFSTI: HC $3.00/MF $0.65

The changes in the infrared spectra of porous glass surfaces produced by sorption of water at room temperature were recorded. Highly dehydroxylated, deuterated, and fluoridated surfaces were examined. Prominent spectral changes are associated with a band at 3703/cm ascribed to surface B–OH structures. There is evidence to show that surface boron is the adsorption center for the hydration of highly degassed porous glass. Direct comparison of highly degassed porous glass surfaces with pure silica surfaces is consequently not valid. Author (TAB)

N67-27080# Case Inst. of Tech., Cleveland, Ohio.
PHOTO-INDUCED REDOX REACTIONS Biennial Report, 1 Jan. 1963–1 Dec. 1966
Jay K. Kochi, Tristam W. Bethea, III, and Nelson E. Hay [1966] 65 p refs
(Contract AF-AFOSR-226-63)
(AFOSR-67-0396; AD-647430) CFSTI: HC $3.00/MF $0.65

Despite the ease of formation of silver ion complexes of olefins, photolysis of a variety of these complexes in several solvents afforded no apparent photoreaction but the cuprous chloride-1,5-cyclooctadiene complex structure of which has been determined has been shown to undergo photoreaction in ether solution at 2537A to produce tricyclo (3.3.0.0) octane. In the decarboxylation of cyclohexane carboxylic acid, the same products were obtained in the thermal reaction and in all of the photolytic ones. The esters and alkylbenzenes show the most pronounced differences in the two methods of decarboxylation; the combined yields of these components in the thermal reaction are over twice those obtained by any photolytic method. The decarboxylation of 2,2-dimethylbutyric acid, a tertiary acid, showed a more obvious difference. In the thermal reaction no 2-methylbutane was produced; in the photolytic reactions, however, this product was found. In the photolysis of primary carboxylic acids, shorter wavelength irradiation, 2537A, produces greater amounts of alkene and dimer than does the 3500A reaction. Author (TAB)

N67-27084*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ELECTRON MAGNETIC RESONANCE
In its Res. Lab. of Electron. 15 Apr. 1967 p 13–14 refs (See N67-27081 14-23)
(Contract DA-28-043-AMC-02536(E))

Production and detection of radicals in the gas phase was reported in a flow system through an Electron Magnetic Resonance (EMR) spectrometer. Brief technical details are also presented on the construction of a rapid-scanning electron paramagnetic resonance (EPR) spectrometer coupled with a flash discharge source. R.Li

N67-27106# Rocket Power, Inc., Pasadena, Calif.
ION REACTIONS IN MATRICES Final Technical Report, 1 Mar. 1966–28 Feb. 1967
C. Barter and S. I. Chan (Calif. Inst. of Tech., Pasadena) Feb. 1967 23 p refs Prepared jointly with Calif. Inst. of Tech., Pasadena
(Contract AF 49(638)-1699)
(AFOSR-67-0688; AD-648266) CFSTI: HC $3.00/MF $0.65

The research was concerned with the basic steps in the chemical behavior of a special class of substances known as positive ions. The experimental technique has consisted of surrounding these ions at low temperature with neutral molecules and observing what chemical products are formed. Prototype experiments have shown that collisions of the positive ions, H(+), Ar(+), and CO2(+) with cyclopropane, in condensed phase, at liq. N2 temperature, result in the isomerization of cyclopropane molecules. Since positive ions of chemical interest are likely to be paramagnetic, measurements were made of the electron paramagnetic resonance, of prototype species at liq. He temperature and higher. Provisions were made for generating paramagnetic substances in situ.
Author (TAB)

N67-27121 Paris Univ. (France). Laboratory of Molecular Spectrochemistry Research.
SYNTHESES OF ORGANIC COMPOUNDS LABELLED WITH STABLE ISOTOPES [SYNTHESES DE COMPOSES ORGANIQUES MARQUES AUX ISOTOPES STABLES] Annual Report, Jul. 1965–Jul. 1966
M. L. Josien Brussels, EURATOM, Apr. 1967 8 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-062-64-7-RISF)
(EUR-3293.f)

Synthesis of methyl and ethyl ethers ($CD_3CH_2OCH_3$, $CH_3CD_2OCD_3$, $CD_3CH_2OCH_3$, $CH_3CD_2OCD_2CH_3$) of aromatic molecules (1-chloro 1–2 deutario benzene, N-methyl-(D_3)aniline, diphenyl-cetimine (D) and of molecules of biological interest (7,8-dideuterio-purine, 4,6-dimethyl (D_3)–2-amino pyrimidine, glycine ^{15}N) have been made. These molecules have been prepared for spectroscopic studies. Isotopic analysis as measured by mass spectroscopy, nuclear magnetic resonance or infrared spectroscopy, are given. Preliminary studies in order to prepare o.terphenyl and 1,8-dibromo phenanthrene are described. The main synthesis procedures which were applied and the corresponding list of publications are mentioned.
Author

N67-27136# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
POSSIBLE EXTENSIONS AND APPLICATIONS OF THE COLLECTIVE MODEL OF THE HYDROGEN BOND [POSSIBILI ESTENSIONI E APPLICAZIONI DEL MODELLO "COLLETTIVO" DEL LEGAME A IDROGENO]
M. Ageno 7 Dec. 1966 24 p refs In ITALIAN; ENGLISH summary
(ISS-66/47) CFSTI: HC $3.00/MF $0.65

The collective model of the hydrogen bond is extended showing that a bound state can exist even when the energies of two unperturbed states (which are obtained neglecting the interaction between the involved molecules) are not exactly the same. It is also shown that, especially in the case of atoms, the tetrahedral hybridized orbitals of which are lacking in electrons, a ring with a double bridge can be formed through a single proton. These extensions make it possible to apply the collective model to the hydrogen bonds of proteins and DNA, and, in the case of the latter, to draw arguments from it to justify the specificity of complementary base pairing.
Author

N67-27139# European Atomic Energy Community, Ispra (Italy). Hauptabteilung Engineering—Waermeuebertragung.
A FLOW CALORIMETER FOR DETERMINING THE MOLECULAR HEAT OF HIGH-BOILER LIQUID VAPORS [EIN STROEMUNGSKALORIMETER ZUR BESTIMMUNG DER MOLWAERMEN VON DAEMPFEFEN HOCHSIEDENDER FLUESSIGKEITEN]
F. W. Reiter Brussels, EURATOM, Mar. 1967 28 p refs In GERMAN; ENGLISH summary
(EUR-3278.d) CFSTI: HC $3.00/MF $0.65

A streaming method is described in which the molar heats of vapors of liquids with high boiling points up to 400°C can be measured. The molar heats of benzene, diphenyl, o- and n-terphenyl were determined in a temperature range corresponding to vapor pressures from 0.05–2 atm. The experimental error is estimated at 2–3%.
Author

N67-27140# Kernforschungsanlage, Juelich (West Germany). Institute fuer Chemische Technologie.
DIFFUSION OF FISSION PRODUCTS IN OVERLAPPING CHEMICAL REACTION. THERMODYNAMIC CALCULATIONS [DIFFUSION VON SPALTPRODUKTEN BEI UEBERLAGERTER CHEMISCHER REAKTION. THERMODYNAMISCHE BERECHNUNGEN]
M. Laser and H. Kirchner Brussels, EURATOM, Feb. 1967 20 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-003-63-1 RGAD)
(EUR-3272.d) CFSTI: HC $3.00/MF $0.65

The heat-formation values for earth alkali and lanthanide carbides were estimated by a Born–Haber cycle process. The vapor pressure over the carbides and consequently the fission-product evaporation rate are to some extent appreciably below those for the corresponding metals. The diffusion through the coating or in the graphite may also be dependent on the vapor pressure over the concentration gradient which is built up. It would further appear, for example, that in the case of porous graphite the mass transport of the fission products also takes place via the gas phase. The considerable differences found by other authors in the diffusion coefficient of, for instance, barium and strontium may be accounted for semi-quantitatively by the different vapor pressures. Effective decontamination of carbide fuel particles by evaporation of the most important neutron poisons at temperatures above 2000°C seems to be extremely tricky, since, while it is true that evaporation rates rise with temperature, the vapor-pressure curves for uranium and fission products tend to approach each other more and more.
Author

N67-27163# Air Force Office of Scientific Research, Washington, D. C.
TWELFTH ANNUAL CHEMISTRY PROGRAM REVIEW Special Scientific Report, Fiscal Year 1966
Anthony J. Matuszko and Edward T. Walford Dec. 1966 260 p refs
(AFOSR-66-1854; AD-647465) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. AEROSPACE CHEMISTRY A. Weissler p 3–14 (See N67-27164 14-06)
2. CHEMICAL REACTIVITY AND MECHANISMS A. J. Matuszko p 14–24 (See N67-27165 14-06)
3. NEW METHODS AND TECHNIQUES W. L. Ruigh p 25–31 (See N67-27166 14-06)
4. INORGANIC CHEMISTRY D. W. Elliott p 32–42 ref (See N67-27167 14-06)
5. POLYMER CHEMISTRY A. J. Matuszko p 43–47 (See N67-27168 14-06)
6. SYMPOSIA E. T. Walford p 48–51 (See N67-27169 14-06)
7. CHEMISTRY PROGRAM STATISTICS p 52–58 (See N67-27170 14-06)
8. COMPLETED PROJECT SUMMARY p 113–236 refs (See N67-27171 14-06)

N67-27164# Air Force Office of Scientific Research, Washington, D. C.
AEROSPACE CHEMISTRY
Alfred Weissler *In its* 12th Ann. Chem. Program Rev. Dec. 1966 p 3–14 (See N67-27163 14-06)

Air Force aerospace chemistry research which focuses on the study of chemical changes under such conditions as very high and low temperatures and pressures, unscreened solar radiation,

intense vibration and sound, high energy radiations such as cosmic rays, and the chemistry of the upper atmosphere; is reviewed. Cited are studies resulting in the development of a method for high precision measurement of the densities of liquid methane, ethane, and other fuels for gas turbine engines at very low temperatures; studies of the chemistry of germane and its derivatives; studies of the electron energy levels in metals, and energy trapping and electronic structure in molecular solids such as naphthalene, anthracene, and the condensed noble gases; the development of advanced shock tube instrumentation (a quadrupole mass spectrometer) for use in laboratory studies of reactions which take place at high temperatures such as those at the nose of a reentry vehicle or inside a jet engine; and studies of the ways in which light energy can be absorbed by a photosensitizer molecule in solution, retained briefly in a metastable triplet state, and then passed along to another type of molecule in the solution to cause a chemical transformation. S.C.W.

N67-27165# Air Force Office of Scientific Research, Washington, D. C.

CHEMICAL REACTIVITY AND MECHANISMS

Anthony J. Matuszko *In its* 12th Ann. Chem. Program Rev. Dec. 1966 p 14–24 (See N67-27163 14-06)

Presented is a review of Air Force supported research focusing on studies of quantum organic chemistry; the chemistry of organosulfur intermediates; phosphorus photochemistry; and the behavior of ketones with phosphorus pentachloride in other solvents. S.C.W.

N67-27166# Air Force Office of Scientific Research, Washington, D. C.

NEW METHODS AND TECHNIQUES

William L. Ruigh *In its* 12th Ann. Chem. Program Rev. Dec. 1966 p 25–31 (See N67-27163 14-06)

Described are highlights of Air Force supported research focusing on the development of new methods and techniques applicable to the field of chemistry. Cited are the development of an atomic fluorescence flame spectrometry method for the high sensitivity determination of zinc, cadmium, mercury, thallium, gallium, and indium; a new method of separation of phosphorus compounds which involves the use of silanized Chromosorb G as a column support; an analytical technique which employs the use of rare earth chelates for the separation of coordination complexes by gas chromatography; a technique for synthesizing uncoordinated gallium hydride; and a technique for improving the resolution of comparatively cheap and compact spectrographs. S.C.W.

N67-27167# Air Force Office of Scientific Research, Washington, D. C.

INORGANIC CHEMISTRY

Denton W. Elliott *In its* 12th Ann. Chem. Program Rev. Dec. 1966 p 32–42 ref (See N67-27163 14-06)

Air Force supported research which is directed toward the understanding of inorganic reactions in non-aqueous as well as aqueous media is reviewed. Cited are studies of chemical coupling; the role of the solvent in inorganic reactions; the structure and stereochemistry of transition metal compounds; the nature and extent of steric influences on the important class of inorganic chemical reactions called bridged electron transfer reactions; and studies which employ nuclear magnetic resonance techniques for elucidating the nature and extent of outer sphere interactions and their interplay with substitution reactions. S.C.W.

N67-27168# Air Force Office of Scientific Research, Washington, D. C.

POLYMER CHEMISTRY

Anthony J. Matuszko *In its* 12th Ann. Chem. Program Rev. Dec. 1966 p 43–47 (See N67-27163 14-06)

Air Force sponsored research in polymer chemistry which focuses on studies of synthetic approaches to novel polymers, and studies of the processes involved in the degradation of existing polymeric materials; is described. S.C.W.

N67-27169# Air Force Office of Scientific Research, Washington, D. C.

SYMPOSIA

Edward T. Walford *In its* 12th Ann. Chem. Program Rev. Dec. 1966 p 48–51 (See N67-27163 14-06)

Presented is a synopsis of five Air Force supported symposia in the field of chemistry during fiscal year 1966. Described are highlights of the following: (1) Conference on Liquid Crystals which was held at Kent State University, Kent, Ohio; (2) Gordon Research Conference on Inorganic Chemistry which was held at New Hampton, New Hampshire; (3) Fifth Rare Earth Research Conference which was held at Iowa State University, Ames, Iowa; (4) Conference on Current and Future Problems in Chemistry at High Temperature which was held at Rice University, Houston, Texas; and (5) Symposium on Electrode Processes which was held at Cleveland, Ohio. S.C.W.

N67-27170# Air Force Office of Scientific Research, Washington, D. C.

CHEMISTRY PROGRAM STATISTICS

In its 12th Ann. Chem. Program Rev. Dec. 1966 p 52–58 (See N67-27163 14-06)

Appropriations and budget statistics for the fiscal year 1966 are presented for the chemistry program sponsored by the Air Force Office of Scientific Research. S.C.W.

N67-27171# Air Force Office of Scientific Research, Washington, D. C.

COMPLETED PROJECT SUMMARY

In its 12th Ann. Chem. Program Rev. Dec. 1966 p 113–236 refs (See N67-27163 14-06)

Summarized are 35 completed projects in the field of chemistry which were sponsored by the Air Force. For each project are presented the names of the principal investigators; inclusive dates; grant number; costs and fiscal year source; names of senior research personnel; a listing of publications generated; and an abstract of objectives and accomplishments. Cited are studies of molecular orbital theory in organic chemistry; properties of solutions of metals in molten salts; solutions in nonaqueous solvents; stable and unstable silyl and germyl compounds; chemical properties of labile species; the oxidation of unsaturated compounds; infrared spectra of molecular crystals; interactions of activated gases with solids; and pi-bonded organosilicon compounds. S.C.W.

N67-27231*# General Applied Science Labs., Inc., Westbury, N. Y.

ANALYSIS OF ERROR GROWTH AND STABILITY FOR THE NUMERICAL INTEGRATION OF THE EQUATIONS OF CHEMICAL KINETICS

D. E. Magnus and Harold S. Schechter [1964] 71 p refs (Contract NAS1-5046)

(NASA-CR-66371) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The only limitation upon the integration stepsize is imposed by the truncation error and the residual error introduced by the linearization of the ordinary differential equations of chemical kinetics. However, the limitation is not severe and the stable procedures produce accurate solutions using a stepsize which is large compared to the maximum stable stepsize of standard procedures. The methods have been applied to the hydrogen–air chemistry system, and for a given problem the amount of machine time was reduced by a factor of 10 to 20 as compared to other methods of integration. For dissociating air chemistry, the method produced accurate solutions with a substantial saving in machine time. The numerical results for these two chemistry systems are reported. Author

N67-27240*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CALCULATION OF COMPLEX CHEMICAL EQUILIBRIA
Frank J. Zeleznik and Sanford Gordon Washington, NASA, 1967 101 p refs Presented at the 4th Ann. State of the Art Symp. on Appl. Thermodyn. of the Am. Chem. Soc., Washington, D. C., 12–14 Jun. 1967
(NASA-TM-X-52303) CSCL 07D

A comprehensive balanced review of complex chemical equilibrium computations is given by considering theoretical and pragmatic aspects of the problem. The pertinent thermodynamic principles are used to derive and compare two alternate formulations of the equations governing chemical and phase equilibria. This is followed by a discussion of some algorithms for solving systems of nonlinear equations. Discussed are those algorithms which are used in equilibrium computations and some that have not been used but are potentially useful. With this background, a historical review is presented of some of the more significant developments in the calculation of complex equilibria. Examples are given of the application of thermodynamic computations to practical problems, and it is pointed out how some common thermodynamic misconceptions can cause difficulties. Author

N67-27247# Societa Richerche Impianti Nucleari, Saluggia (Italy). Centro Richerche Nucleari.
ACTIVATION ANALYSIS AT THE SORIN CENTER [L'ANALISI PER ATTIVAZIONE AL CENTRO SORIN]
R. Malvano and E. Zimmer 1967 10 p refs In ITALIAN Presented at Convegno sulla Chimica delle Radiazioni e Sui Radioisotopi, Rome, 19–21 Jan. 1967
(SORIN-105) CFSTI: HC $3.00/MF $0.65

Reactor technology at SORIN nuclear research center is reported. Applications of methods were developed for the following topics: irradiation, thermal neutron activation, chemical interference in reactors, radiochemistry, and combustion materials. Industrial applications are also mentioned briefly. Transl. by R.Ll.

N67-27258 European Atomic Energy Community, Ispra (Italy). Chemistry Dept.
THE RADIOLYTIC AND PYROLYTIC DECOMPOSITION OF ORGANIC COOLANTS. V: THE THERMAL DECOMPOSITION OF o-TERPHENYL, m-TERPHENYL AND p-TERPHENYL IN THE PRESENCE OF ATTAPULGUS CLAY
G. Juppe and H. Rau Brussels, EURATOM, Mar. 1967 39 p refs
(EUR-3281.e) CFSTI: $3.00

The kinetics of the pyrolysis of pure o-, m- and p-terphenyl and of material mixed with Attapulgus clay were studied. Ten to twelve times more o-, m- and p-terphenyl was decomposed in the clay catalyzed experiments and a strong isomerization of o- into m- and p-, and m- into p-terphenyl appeared. Twice as much benzene and diphenyl was formed in the clay added runs. Similar differences were obtained for the quaterphenyl, triphenyl, and triphenylbenzene formations. From the catalyzed experiments 50 times as much total gas was found consisting of 37% hydrogen, 19% methane, 7% ethane, 2% propane, 1.5% n-pentane, 3.8% isopentane, 2.5% ethylene, 0.4% acetylene, 0.9% propene, and 2% butenes. The uncatalyzed runs yielded 82% hydrogen, 4% methane, 1% ethane, 0.4% propane, 0.2% n-pentane, 0.3% isopentane, 10% ethylene, 2.8% acetylene, 1.2% propylene and 2% butenes. It is suggested that the thermal decomposition of pure terphenyls follows a radical mechanism while the clay catalyzed pyrolysis follows a carbonium ion mechanism. Author

N67-27259# European Atomic Energy Community, Ispra (Italy). Chemistry Dept.
THE RADIOLYTIC AND PYROLYTIC DECOMPOSITION OF ORGANIC COOLANTS. II: THE POSTPYROLYSIS OF PREIRRADIATED OM$_2$
G. Juppe, G. Wedekind, H. Rau, and G. Schuetz Brussels, EURATOM, Mar. 1967 25 p refs
(EUR-3287.e) CFSTI: HC $3.00/MF $0.65

The postpyrolysis of in pile irradiated terphenyls (OM2) causes a higher rate of decomposition than the pyrolysis of unirradiated material. A higher formation of gaseous hydrocarbons, benzene, diphenyl and higher boiling aromatic compounds are also observed. The kinetics of the decompositions are described. The possible mechanisms responsible for the observed differences of reaction rates and product compositions are discussed. Author

N67-27295* National Biomedical Research Foundation, Silver Spring, Md.
THERMODYNAMIC EQUILIBRIUM IN PREBIOLOGICAL ATMOSPHERES OF C, H, O, N, P, S, AND Cl
M. O. Dayhoff, E. R. Lippincott, R. V. Eck, and G. Nagarajan Washington, NASA, 1967 274 p refs
(Grant NSR-21-003-002; NGR-21-002-059; NGR-09-015-023)
(NASA-SP-3040) CFSTI: HC $3.00/MF $0.65 CSCL 07B

A computational system for the equilibrium of many compounds in an ideal gas mixture was developed in connection with the study of the thermodynamic equilibrium of prebiological atmospheres containing varying amounts of C, H, O, N, P, S, and Cl. An introduction to the methodology, the tables for the computer survey, and the mathematical models are presented. Appendixes deal with thermodynamic equilibria in planetary atmospheres, and relate thermodynamic equilibrium to the inorganic origin of organic compounds. M.W.R.

N67-27326# Junta de Energia Nuclear, Madrid (Spain). Division de Quimica.
STUDY ON THE PREPARATION AND STABILITY OF URANIUM CARBIDE SAMPLES FOR THE DETERMINATION OF OXYGEN, HYDROGEN, AND NITROGEN BY FUSION UNDER HIGH VACUUM [ESTUDIO SOBRE LA PREPARACION Y ESTABILIDAD DE LAS N MUESTRAS DE CARBURO DE URANIO PARA LA DETERMINACION DE OXIGENO, HIDROGENO Y NITROGENO POR FUSION EN ALTO VACIO]
M. Perez Garcia Nov. 1965 14 p refs In SPANISH; ENGLISH summary
(JEN-170-DQ/I-60)

In view of the high reactivity of uranium carbide, the method used for preparing the sample for analysis of its gas content has a decisive influence on the analytical results. The variation in the O_2, H_2, and N_2 content of the uranium carbide has been studied with the methods utilized for the sample preparation (grinding and cutting). Furthermore, these variations were studied as a function of time, depending on the medium of storage of the uranium carbide: normal atmosphere and argon atmosphere. In order to determine the O_2, H_2, and N_2, the method of analysis by fusion under high vacuum, using a Pt bath which has already been applied to the analysis of uranium and some of its compounds. Author (NSA)

N67-27399# Bureau of Mines, College Park, Md. Metallurgy Research Center.
EFFECTS OF ULTRASONICS ON ELECTRODEPOSITION OF COPPER ALLOYS FROM CYANIDE ELECTROLYTES
Charles B. Kenahan, David Schlain, and Edmond Chin Apr. 1967 38 p refs
(BMRI-6938) CFSTI: HC $3.00/MF $0.65

The effects of ultrasonic radiation on the electrodeposition of copper–zinc, copper–cadmium, and copper–tin alloys from cyanide baths were investigated by the Bureau of Mines at frequencies of 18.5 and 38 kilocycles per second, and at acoustic intensities up to 0.5 watt per cm^2. Significant changes occurred in the composition of the deposited alloys; some of these deposits were brighter, harder, more adherent, or of finer grain size than

nonirradiated deposits. The irradiated deposits were also smoother and less porous, and they afforded better corrosion protection for the substrate metal in sodium chloride solution. The limiting current densities of the cyanide baths were increased by the application of ultrasonics. Anode and cathode current efficiencies also were increased, and cell voltages were lowered; the relationship of these effects to current density is discussed. Electrode potential measurements showed significant depolarization effects at both electrodes during ultrasonic irradiation. The resulting decrease in cell voltage was due chiefly to depolarization at the anode, and the anode became less passive. Author

N67-27400# Bureau of Mines, Amarillo, Tex. Helium Research Center.

ISOTOPIC ABUNDANCE OF NEON, ARGON, AND NITROGEN IN NATURAL GASES. RELATIONSHIP TO HELIUM GENESIS

Lowell Stroud, Thomas O. Meyer, and David E. Emerson Apr. 1967 32 p refs

(BM-RI-6936) CFSTI: HC $3.00/MF $0.65

Ten natural gases containing from 0.023 to 8.4% helium were investigated. In seven high-helium samples, the isotopic abundance of Ne^{21} was greater than in the atmosphere, being supplemented by 33 to 85% of excess or "radiogenic" Ne^{21}. The ratio of $He^4/Ne^{21}_{(rad)}$ in these gases was evaluated and found to vary between 2.9×10^7 and 5.9×10^7, a factor of approximately 2. Argon concentrations were determined by the isotope dilution method. The isotopic ratios of Ar^{40}/Ar^{36} in the high-helium gases were from 5 to 75 times the atmospheric value, with the Ar^{40} being about 80 to 99% radiogenic in nature. The ratios of $He^4/Ar^{40}_{(rad)}$ in all 10 gases were evaluated and found to range from 4 to 18. The isotopic ratio of N^{14}/N^{15} in four of the high-helium gases was essentially the same as in the atmosphere; in three cases it was approximately 5% higher than the atmospheric value of 272.0. The genesis of nitrogen and the relationship of nitrogen to helium in natural gases were reviewed and are discussed in terms of a theory for the concurrent generation of nitrogen, helium, radiogenic neon 21, and petroleum. Author

N67-27417*# National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF THE CATALYTIC INTERACTION OF HYDROGEN CHLORIDE AND METHANOL. PART II: KINETICS OF DEHYDRATION OF METHANOL AND HYDROCHLORINATION OF DIMETHYL ETHER ON CATALYSTS USED FOR VAPOR-PHASE SYNTHESIS OF METHYL CHLORIDE [ISSLEDOVANIYA V OBLASTI KATALITICHESKOGO VZAIMODEYSTVIYA KHLORISTOGO VODORODA I METANOLA. II: KINETIKA REAKTSIY DEGIDRATATSII METANOLA I GIDROKHLORIROVANIYA DIMETILOVOGO EFIRA NA KATALIZATORAKH PAROFAZNOGO SINTEZA KHLORISTOGO METILA]

Ya. B. Svetlanov and R. M. Flid May 1967 7 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 40, no. 12, 1966 p 3055–3059

(NASA-TT-F-10937) CFSTI: HC $3.00/MF $0.65 CSCL 07C

The kinetics of methanol dehydration and dimethyl ether hydrochlorination in the catalytic vapor-phase synthesis of chloromethane for organosilicon polymers and butyl rubber are discussed, with reaction formulas for various catalysts and second-order equations for the rate of reaction. The rate of reaction of dimethyl ether with hydrogen chloride is proportional to the first power of the ether and HCl concentration, with the kinetics described by $w = k \cdot p_{HCl} \cdot p_{(CH_3)_2O}$. Zinc chloride was found to be a more selective catalyst for chloromethane synthesis than alumina. Author

N67-27428*# Union Carbide Corp., Bound Brook, N. J. Plastics Div.

SATURATED HYDROCARBON POLYMERIC BINDER FOR ADVANCED SOLID PROPELLANT AND HYBRID SOLID GRAIN Quarterly Report, 1 Nov. 1966–31 Jan. 1967

J. E. Potts, ed. 31 Jan. 1967 21 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951210)

(NASA-CR-84443; QR-5) CFSTI: HC $3.00/MF $0.65 CSCL 07C

A small, continuous, high pressure tube reactor was used to carry out a series of ethylene–neohexene copolymerizations using DMAB as the initiator. These experiments demonstrated that even in the short residence times which exist in the tube reactor (1–2 minutes), radicals from DMAB disproportionate extensively to yield the hydrogen transfer agent methyl isobutyrate. A very promising route to a prepolymer of higher functionality than attainable with DMAB or AIBN initiation is being examined. This involves the telomerization of ethylene/neohexene with CCl_4, which places a Cl group on one end of the molecule and CCl_3 groups on the other end. Another reaction sequence for increasing functionality which involves the use of organic disulfides as chain transfer agents was investigated. In order to apply this concept to ethylene–neohexene copolymerization, three symmetrical disulfide compounds which contain ester functionality were synthesized. Author

N67-27431*# Tyco Labs., Inc., Waltham, Mass.

DEVELOPMENT OF CATHODIC ELECTROCATALYSTS FOR USE IN LOW TEMPERATURE H_2/O_2 FUEL CELLS WITH AN ALKALINE ELECTROLYTE Quarterly Report, 1 Jan.–31 Mar. 1967

J. Giner and J. Parry 31 Mar. 1967 73 p refs

(Contract NASw-1233)

(NASA-CR-84440; QR-7) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Carbides and nitrocarbides of nickel, cobalt and nickel/cobalt alloys were tested for activity in the reduction of O_2 in basic electrolyte. Nickel carbide was also prepared by decomposition of nickel acetate. These catalysts were tested in practical electrode structures—PTFE bonded screen electrodes. Electrodes made with Ni_3C obtained by acetate decomposition showed an activity in the best case of 100 ma/cm^2 at 750 mv and a limiting current of >250 ma/cm^2. However, the highest performance measured for the catalyst was 37 ma/cm^2 at 750 mv and a limiting current of <100 ma/cm^2. With the exception of the nitrocarbides, the activity of the nickel/cobalt alloys is in the order 3 Ni/Co > Ni/Co > Ni/3Co. For example, with the carbides of these alloys the current densities at 750 mv were 24 ma/cm^2, 16 ma/cm^2, and 12 ma/cm^2, respectively. It should be stressed here that the actual current densities recorded do not truly reflect the intrinsic activity of these catalysts, which are potentially capable of supporting much higher current densities. Author

N67-27439*# Florida Univ., Gainesville. College of Engineering.

A STUDY OF GAS SOLUBILITIES AND TRANSPORT PROPERTIES IN FUEL CELL ELECTROLYTES Semiannual Report, 1 Sep. 1966–28 Feb. 1967

Robert D. Walker, Jr. 29 Mar. 1967 49 p refs

(Grant NGR-10-005-022)

(NASA-CR-84432; SAR-3) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Work described in this report covered (1) density measurements, (2) correlation of vapor pressures, (3) measurements of the solubility of oxygen in KOH solutions, and (4) measurements of the mutual diffusivity of water in KOH. By means of a modified balance technique using a silver plummet, measurements of the density of aqueous KOH solutions were made up to a temperature of 161.4°C and KOH concentration of 77.1 wt. %. Good agreement with previously published data was noted. Vapor pressures of KOH solutions were correlated by means of the Antoine equations

using a digital computer for evaluation of the constants. It was found that the data were best represented at each concentration by one equation for low temperatures and another equation for high temperatures. The transition temperature from the low to the high temperature region increased with KOH concentration. Oxygen solubilities were extended to 100°C and a KOH concentration of 56 wt. % after refining the technique. The present technique is limited to the range indicated by impurities in the helium used as a stripping gas. Further improvements in the apparatus and technique are being investigated to permit extension of the measurements to higher temperatures and KOH concentrations. Measurements of the mutual diffusivity of water in aqueous KOH solutions were started and a few data are reported. Author

N67-27442# Florida Univ., Gainesville. Dept. of Chemistry.
SPECIAL GAS CHROMATOGRAPH FOR USE IN GAS PHASE RADIATION CHEMISTRY
Edgar Heckel and Robert J. Hanrahan Apr. 1967 5 p Presented at 153d Natl. Meeting, Am. Chem. Soc., Miami Beach, Fla.
(Contract AT(40-1)-3106)
(ORO-3160-21; CONF-670401-6) CFSTI: HC$3.00/MF$0.65

A special gas chromatograph was constructed for the analysis of products formed during the radiolysis of gas mixtures. The apparatus consists of two indpendent chromatographic units connected only through the common sample inlet system. The sample inlet system consists of two sampling loops, a part for attaching the sample, a part for removing a gas aliquot for external analysis (fluoride ion), and an automatic Toepler pump which is the heart of the system. The entire inlet system can be evacuated by a two-stage rotary vacuum pump when all valves are in the proper positions. NSA

N67-27443# Maryland Univ., College Park. Dept. of Chemistry.
STABLE ISOTOPE TRACER STUDIES Progress Report, 1 Jun. 1966–31 May 1967
Gilbert Gordon 31 May 1967 11 p
(Contract AT(40-1)-2858)
(ORO-2858-18) CFSTI: HC$3.00/MF$0.65

Results are reported for studies on: kinetics of reaction between chlorine dioxide and potassium iodide in aqueous solution; and data handling in ^{18}O tracer studies. Developments are also reported for studies on: reactions between (1,10-phenanthroline) iron(II) sulfate and aqueous solutions of $NaClO_2$ and ClO_2; uranium(IV) and (V) reactions with dissolved chlorine and aqueous HOCl; and diffusion of ^{18}O in single crystals of metal oxides. NSA

N67-27460# Arkansas Univ., Fayetteville. Dept. of Chemistry.
TRACER AND ISOTOPE EFFECT STUDIES IN ORGANIC CHEMISTRY Annual Progress Report
Arthur Fry 15 Jan. 1967 71 p refs
(Contract AT(40-1)-3234)
(ORO-3234-4) CFSTI: HC$3.00/MF$0.65

Developments are reported for studies on: rearrangement of aliphatic ketones on solid supported phosphoric acid catalyst; disproportionation in acid-catalyzed rearrangements of aliphatic ketones; reactions of aromatic–aliphatic ketones on solid supported phosphoric acid catalyst; rearrangements of carbon-14 carbonyl and phenyl-labeled phenyl benzhydryl ketone and phenyl benzyl ketone; rearrangement of pivalophenone and related compounds in perchloric acid using ^{14}C tracer; chlorine isotope effects in solvolysis of substituted benzoyl chlorides; ^{14}C isotope effects on nucleophilic displacement reactions of substituted benzyl chlorides and on timing of bonding changes in the reactions of electron deficient species; ^{18}O exchange on substituted nitrobenzenes and between p-substituted benzophenones and water at low acid and base concentrations; ^{15}N exchange between substituted benzamides and ammonia; and stereochemistry of carbene and carbenoid insertion reactions. NSA

N67-27474# Columbia Univ., New York. Radiation Lab.
INTERACTION BETWEEN NEUTRAL ATOMS AND CRYSTALLINE SURFACES Final Report, 1 Aug. 1964–31 Jul. 1966
P. Kusch and D. Raskin Feb. 1967 9 p
(Grant DA-ARO(D)-31-124-G568)
(AROD-3313-1; AD-648756) CFSTI: HC$3.00/MF$0.65

The work dealt with the observation of the interaction between a neutral molecule or atom and a metal surface. This interaction leads to an attractive force between the surface and the molecule. The force has not heretofore been directly observed; molecular deflections were observed during this project that can only be ascribed to the force in question. Author (TAB)

N67-27478# Naval Ordnance Lab., Washington, D. C. Electrochemistry Branch.
SHORT-PULSE TECHNIQUES. PART 2: PERTURBATION TIMES IN ALKALI-HALIDE SYSTEMS
Bernard J. Piersma, Sigmund Schuldiner, and Theodore B. Warner 17 Jan. 1967 24 p refs
(NRL-6458; AD-647976) CFSTI: HC$3.00/MF$0.65

A new technique involving the perturbation of a system from equilibrium using very short galvanostatic pulses and miniature cells was applied to study of the electrical double layer at Pt electrodes. The perturbation time, the time required for the double layer to begin charging, was determined for hydrogen- and alkali metal-halide systems and for reversible hydrogen systems in several acids and NaOH. The perturbation time was essentially independent of charging-current density and of the anion in solution but was strongly dependent on the cation species and electrolyte concentration. Models to explain the absence of electrode polarization during the initial flow of charge into the double layer are discussed. A model which involves a very fast Faradaic process and which is consistent with the experimental observations is proposed. It is suggested that the perturbation time, which is less than 100 nanosec for 1 M solutions, represents the time required for movement of ions into or out of the compact double layer. Author (TAB)

N67-27492# California Univ., Berkeley. Lawrence Radiation Lab.
THE CONFIGURATION AND ENERGY OF DEFECTS ON THE (100) SURFACE OF A MOLECULAR CRYSTAL
J. J. Burton and George Jura Aug. 1966 25 p refs Presented at Symp. on Fundamentals of Gas-Surface Interactions, San Diego, Calif.
(UCRL-17161; CONF-661209-3) CFSTI: HC$3.00/MF$0.65

Using a Lennard–Jones 6-12 potential function to represent the interactions of the atoms, the binding energies of neon, argon, and krypton atoms in and above the (100) surface of argon were computed. Relaxations of the defects were considered and found to be small; however relaxation appreciably affected the energies of the defects. The binding energies of neon, argon, and krypton atoms above the (100) argon surface were 687, 1367, and 1682 cal, respectively. The binding energies of neon, argon, and krypton atoms in the (100) argon surface were 1290, 2603, and 3160 cal, respectively. Relaxation appreciably affected the binding energies. The free energy of formation of a mole of vacancies on the (100) surface of argon was found to be $\Delta F = 1236 - 3.58\ T$ cal. This implies that at the melting point of argon there is one vacancy per three hundred (100) surface sites on 2×10^{12} per cm^2 of surface. Author (NSA)

N67-27504*# General Dynamics Corp., Groton, Conn. Electric Boat Div.
THE SYNTHESIS AND UTILIZATION OF LOW MOLECULAR WEIGHT OZONIDES FOR AIR REVITALIZATION Supplement to Interim Report of 14 Nov. 1965

A. W. Petrocelli, J. A. Marriott, R. Uno, and A. Capotosto, Jr. 14 Jun. 1966 114 p refs
(Contract NASw-559)
(NASA-CR-84469; U-413-66-081) CFSTI: HC $3.00/MF $0.65 CSCL 07C

A study of the thermal stability of sodium superoxide, sodium peroxide, and lithium peroxide was conducted. The techniques of differential thermal analysis, thermogravimetry and differential thermogravimetry were used in evaluating the effects of metallic oxide and metallic–organic catalysts on the temperatures and rates of decomposition of these compounds. Results indicated that catalysts do not lower the thermal decomposition at a given elevated temperature. The effect of preconditioning sodium superoxide samples by exposure to humid atmospheres was also studied. Such conditioning lowers the decomposition temperature slightly. Isothermal kinetic data was also generated for a number of catalyzed systems. Magnetic susceptibility studies for calcium superoxides were extended to include measurements at temperatures ranging from −178° to 38°C. Author

N67-27505*# Grace (W. R.), and Co., Clarkesville, Md. Washington Research Center.
SYNTHESIS OF LINEAR, DOUBLE CHAIN, LADDER POLYMERS FROM SUBSTITUTED TETRAPHOSPHONITRILES Quarterly Progress Report, Dec. 1966–Feb. 1967
Bernard Grushkin, Robert M. Murch, T. S. Soddy, and T. Bieniek 14 Mar. 1967 26 p
(Contract NASw-1415)
(NASA-CR-84471) CFSTI: $3.00 CSCL 07C

Thermal polymerization of β-trans-$[OPN(NHCH_3)]_4$ requires higher temperatures than does the thermal polymerization of $[OPN(NH_2)]_4$. Because mono, di and trimethylamine and ammonia are eliminated during the polymerization, the resulting product cannot be well characterized. Attempts to further polymerize low molecular weight polymers of β-trans-$[OPN(NH_2)]_4$ have not been successful. It is believed that small amounts of water absorbed by the solid polymer cause partial hydrolysis at higher temperatures which result in depolymerization. Low molecular weight polymers have been prepared by treating α-trans-$[OPN(NH_2)]_4$ with $CuSO_4{\cdot}H_2O$, $NiCl_2$ and $CoCl_2$. Thermal deammoniation begins at a lower temperature when $CuSO_4$ is present. The resulting polymers are of low molecular weight, approximately 3000–4000. Reaction of β-trans-$[OPN(NH_2)]_4$ with pyromellitic dianhydride in DMF at high temperatures results in the formation of a black insoluble solid. At room temperature a chloroform soluble product is formed that is believed to be a 1:1 condensation compound. Author

N67-27526*# Farnham (Frank C.) Co., Philadelphia, Pa.
SYNTHESIS AND PROPERTIES OF POLYBENZIMIDAZOPYRROLONE [SINTEZ I SVOYSTVA POLIBENZIMIDAZOPIRROLONA]
E. N. Teleshov and A. N. Pravednikov May 1967 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 172, no. 6, 1967 p 1347–1349
(Contract NASw-1497)
(NASA-TT-F-10985) CSCL 07C

Synthesis of a new polymer with an aroylenebenzimidazole structure from the polycondensation of 3,3'-diaminobenzidine with the dianhydride of pyromellitic acid in a solution of dimethylformamide. The reaction order given is most important since changing the order will produce an insoluble gel rather than the desired polymer solution. Films of the polyamidoamino acid (stage I) were studied by infrared spectroscopy, subjected to cyclization, and the cyclated films (benzimidazopyrrolone, stage II) again studied. Author

N67-27537*# National Aeronautics and Space Administration, Washington, D. C.
METHODS FOR PREVENTION OF HEATING OF AN ABSORBENT BY INFRARED RADIATION IN STUDIES ON THE SPECTRA OF ABSORBED MOLECULES [METODY ISKLYUCHENIYA NAGREVANIYA ADSORBENTA INFRAKRASNYM IZLUCHENIYEM PRI ISSLEDOVANII SPEKTROV ADSORBIROVANNYKH MOLEKUL]
G. A. Galkin, A. V. Kiselev, and V. I. Lygin Jun. 1967 5 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 41, no. 3, 1967 p 740–742
(NASA-TT-F-11008) CFSTI: HC $3.00/MF $0.65 CSCL 07D

A method is discussed for preventing internal heating of an adsorbent in studies on the interaction of adsorbed molecules and the surface in quantitative comparisons of spectral and adsorption data from infrared spectra. Placing the specimen in a resolved beam of infrared radiation, so as to cause a monochromatic light beam to pass through it, will effectively prevent heating. The modified cell, used in the two-beam system of the UR-10 spectrometer, is described. Author

N67-27546*# Tyco Labs., Inc., Waltham, Mass.
DEVELOPMENT OF CATHODIC ELECTROCATALYSTS FOR USE IN LOW TEMPERATURE H_2O_2 FUEL CELLS WITH AN ALKALINE ELECTROLYTE Quarterly Report, 1 Oct.–31 Dec. 1966
J. Giner, J. Parry, L. Swette, and R. Cattabriga 31 Dec. 1966 88 p refs
(Contract NASw-1233)
(NASA-CR-84459; Q-6) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Carbides, nitrides, nitrocarbides, and carbonitrides of iron were examined for catalytic activity in the oxygen reduction reaction in 2N KOH at 75°C. Thirty-three compounds were tested, and a summary of their activities is given. The activities were very dependent on the way in which the catalysts were inducted, i.e. initially exposed to oxygen. A sample of $\chi - Fe_2C$ (#11C) when exposed directly to air showed a current of 3 ma/cm^2 at 600 mv vs. RHE; this increased to 42 ma/cm^2 at 600 mv when the catalyst was first immersed in petroleum ether. The petroleum ether was replaced successively by diethyl ether, acetone, and methanol, the catalyst being covered by solvent at all times until the methanol was allowed to evaporate slowly in air. Author

N67-27552# Chemical Lab. RVO–TNO, Rijswijk (Netherlands).
THE FILTRATION OF AEROSOLS BY GLASS FIBRE FILTERS. I: INFLUENCE OF THE AEROSOL PARTICLE SIZE AND THE LINEAR FLOW VELOCITY [DE FILTRATIE VAN AEROSOLEN DOOR GLASVEZELFILTERS. I: INVLOED VAN DEELTSES-GROOTTE EN DOOVOERSNELHEID]
J. F. Van der Wal and L. A. Clarenburg Feb. 1967 21 p refs In DUTCH; ENGLISH summary
(TDCK-47902; Rept.-1967-4) CFSTI: HC $3.00/MF $0.65

The influence of aerosol particle size and linear flow velocity on the penetration of a di-butyl-phtalate (DBP) aerosol through glass fiber filters has been described. From the results some conclusions, valid for DBP-aerosols, could be drawn: (1) The negative logarithm of the penetration is proportional to the aerosol particle diameter within the range of diameters investigated. (2) The relation between penetration and linear flow velocity shows a maximum. (3) The velocity at which maximum penetration occurs is dependent on the aerosol particle size; for small particles penetration is maximal over a wide range of velocities. (4) The more efficient the filters are, the stronger is the dependence on the penetration on aerosol particle size and on the linear velocity. For this reason the use of the hetero-dispers aerosol, such as the currently used sodium chloride aerosol, for quantitative standard filter tests is strongly dissuaded. Author

N67-27609*# Scientific Translation Service, La Canada, Calif.
RECENT PROGRESS IN POLYMER SYNTHESES
Yoshio Iwakura and Fujio Toda Washington, NASA, Jun. 1967 31 p refs Transl. into ENGLISH from Yukigosei Kagaku Kyokai Shi (Tokyo), v. 24, no. 12, 1966 p 1126–1141
(Contract NASw-1496)
(NASA-TT-F-10982) CSCL 07C

Highlights of polymer syntheses involving the product and the chemical synthesis method itself are presented. Syntheses of heat-resisting polymers such as aromatic polyamides, aromatic polymers containing heterocycles, polysulfones, and polyparaxylene, polyphenyleneoxide, and polyimide are discussed. In connection with the heat-resistant polymers, various ladder-type polymers are described. A new reaction, which is a synthesis to make a 5-membered ring by reacting 1,3-dipolar compound with a dipolarphile is examined. Other topics discussed include: syntheses of poly-amino acid, new ring-opening polymerization, syntheses of polymers containing sulfur, isomerization polymerization, polymerization of cyclo olefins, stereospecific polymerization of acrylic ester, copolymer of styrene and methylmethacrylate by lithium, and synthesis of crystalline alternating copolymers. S.P.

N67-27622# United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
IMPROVEMENTS IN THE DETERMINATION OF NITROGEN IN PLUTONIUM MONONITRIDE AND URANIUM HIGHER NITRIDES BY CHEMICAL METHODS
G. W. C. Milner and I. G. Jones Nov. 1966 25 p refs
(AERE-R-5329) HMSO: 3s 6d

In an improved Kjeldahl method for plutonium mononitride, the sample is transferred directly to the flask of the distillation apparatus by means of an aluminium sachet which is allowed to dissolve in sodium hydroxide solution. Ammonia produced from the nitride sample is removed with argon. The method is direct and fairly rapid, since the analysis of a sample can be completed in under 30 minutes. The coefficient of variation for the determination is better than 0.5%. The dissolution of uranium higher nitrides in mineral acids has been improved by heating overnight at 195°C in a sealed Pyrex tube. For samples up to $UN_{1.5}$ concentrated hydrochloric acid is employed, whereas a mixture of this acid with 5% hydrofluoric acid is used for those with compositions of $UN_{1.5}$ and higher. The sample solution is transferred to sodium hydroxide in the Kjeldahl distillation flask and the determination is completed as for plutonium mononitride. Results by this method are in fair agreement with those obtained by the Damus and inert gas fusion methods of analysis. The coefficient of variation for a determination is better than 0.9%. Author

N67-27625# United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
SOL-GEL STUDIES. PART I: URANIA PREPARATION OF SOLS, AGGREGATE AND SPHERES
E. S. Lane, J. M. Fletcher, A. C. Fox, M. J. Holdoway, K. R. Hyde et al Dec. 1966 19 p refs
(AERE-R-5241) HMSO: 3s 6d

Various routes for the production of uranium(IV) sols have been examined and selected for the production of 100 g. batches of urania as microspheres and as aggregate. Uranyl nitrate solutions were catalytically reduced with hydrogen at atmospheric pressure to U(IV) from which hydrated U(IV) oxide was precipitated, centrifuged and washed prior to being peptised to a sol. The sols were gelled either by evaporation to give aggregate, or in an immiscible organic phase to give microspheres. After calcination at 1150°C in hydrogen, the O/U ratio in the products was 2.00+0.02 and the densities were 95–96% of the theoretical value. The crushing strength of individual microspheres (250–350μ) was up to 5 kg. Author

N67-27640# Louisville Univ., Ky.
ELECTROMAGNETIC RADIATION CHEMISTRY Final Report, 15 Mar. 1963–31 Aug. 1966
Thomas H. Crawford 27 Jan. 1967 34 p
(Contract DA-49-193-MD-2411)
(AD-646645) CFSTI: HC $3.00/MF $0.65

An investigation of the interaction of the enzyme trypsin with magnetic fields was undertaken. It appears that under the conditions studied there is no detectable magnetic effect on the activity of this enzyme. ESR was used to determine structural changes which might be induced in copper II-trypsin solutions on exposure to magnetic fields of 14,000 gauss. The bonding parameter alpha square was evaluated for several amino acid, peptide and trypsin complexes with copper II ions at liquid nitrogen temperatures. The changes in the nature of the metal to ligand bonding is reflected in changing values of alpha square as the pH is varied. There appears to be a reasonable correlation between those structures proposed in the literature as determined by spectrophotometric and potentiometric techniques and the values of alpha square as determined from esr measurements. Of particular interest is the marked change in the nature of the bonding in the trypsin--copper II complex over the range pH 5-6, which suggests a notable rearrangement from primarily carboxylate bonding sites to amide and amine bonding sites. There does not appear to be any detectable change in esr parameters on exposure of trypsin-copper II samples to magnetic fields of approximately 14,000 gauss. Author (TAB)

N67-27694# Polish Academy of Sciences, Warsaw.
EXTRACTION OF CHROMIUM (VI) FROM SULPHURIC ACID SOLUTIONS WITH TRI-n-OCTYLAMINE [EKSTRAKCJA CHROMU(VI) Z ROZTWOROW KWASU SIARKOWEGO ROZTWORAMI TROJ-n-OKTYLOAMINY]
Czeslaw Deptula 1966 18 p refs In POLISH; ENGLISH summary
(Rept.-772/XIII/C)

The effect of concentration of sulfuric acid, ammonium sulfate, sodium dichromate, and extractant on the extraction of chromium (VI) with tri-n-octylamine solutions was investigated. These studies along with the measurements of absorption spectra of chromium (VI) in the organic phase permitted the determination of the composition of the extracted compounds $(R_3NH)_2Cr_2O_7$ and $R_3NH_2Cr_2O_7$. Author

N67-27696# Polish Academy of Sciences, Warsaw.
APPLICATION OF RADIOISOTOPES TO THE STUDY OF THE PROCESSES OF CONTINUOUS DIFFUSION IN CONFECTIONERIES [APPLICATION DES RADIOISOTOPES A L'ETUDE DU PROCESSUS DE LA DIFFUSION CONTINUE DANS LES SUCRERIES]
Przemyslaw M. Hoffmann, Waclawa Gawlowska, Stefan Cieslik, Andrzej Poczynako, and Stanislaw Gawrych Oct. 1966 24 p ref In FRENCH
(Rept.-759/XXII/J)

Radioactive sodium 24 tracers were used in a study of beet sugar. Absorption properties of various radioisotopes were considered, and ethylenediaminetetraacetic acid was chosen for the purpose. It was determined that the flow from the diffuser was not rectilinear, and does not have uniform velocity. Transl. by R.Ll.

N67-27703*# Woods Hole Oceanographic Institution, Mass.
CARBON ISOTOPE FRACTIONATION IN THE SYSTEM CO_2 (GAS)–CO_2(AQUEOUS)–HCO_3^-(AQUEOUS)
W. G. Deuser and E. T. Degens [1967] 13 p refs
(Contract NSR-22-014-001)
(NASA-CR-84428) CFSTI: HC $3.00/MF $0.65 CSCL 07B

Carbon isotope fractionation between gaseous carbon dioxide and aqueous bicarbonate decreases from 9.2 to 6.8% over the

temperature range 0° to 30°C. This fractionation occurs in the hydration stage, not in the passage of atmospheric CO_2 through the air–water interface. Author

N67-27714# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF EXPLOSIVE SUBSTANCES
K. K. Andreyev and A. F. Belyayev 7 Oct. 1966 859 p refs Transl. into ENGLISH of the book "Teoriya Vzryuchatykh Veshchestv" Moscow, Gos. Nauchno-Tekhn. Izd. Oborongiz, 1960 595 p
(FTD-MT-64-242; TT-67-60200; AD-643597) CFSTI: HC $3.00/MF $0.65

The basic physicochemical properties essential for the production of explosives are discussed. Application of the theory of slow thermal transformation, combustion and detonation of explosives and the destructive effects of explosion are also considered. TAB

N67-27729 Lockheed Missiles and Space Co., Palo Alto, Calif.
UTILIZATION OF CHEMICAL METHODS FOR DOSIMETRY OF NUCLEAR REACTOR RADIATION
B. G. Dzantiev and E. P. Kovaleva [1967] 6 p refs Transl. into ENGLISH from Vesti Akad. Navuk Belarusk. SSR, Ser. Fiz.-Tekh. Navuk (Minsk), no. 1, 1967 p 47–51

Dosimetry of the vertical experimental channels has been carried out on the IRT-2000 apparatus by utilizing chemical dosimetry methods. Glucose and ferrosulfate methods were used. The glucose method was proposed for dosimetry of gamma and mixed gamma-neutron fields. Oxidation-reduction processes occur in a glucose dosimetry solution subjected to radiation as a result of the radiolysis of water, culminating in a diminution of the carbon concentration and in the formation of new materials. The chemical transformations caused by radiation may be measured quantitatively: (a) by means of the change in the optical activity of the solution; and (b) by means of the absorption spectra of the exposed solutions. The ferro-sulfate dosimeter system (Fricke dosimeter) is studied most and most often used. Utilization of this system is based on the phenomenon of radiation oxidation of the divalent iron under the effect of the radiation, in ferrous oxide and sulfuric acid solutions. Author

N67-27734# Bureau of Mines, Rolla, Mo. Metallurgy Research Center.
METALLURGICAL TESTING OF HAWAIIAN FERRUGINOUS BAUXITES Concluding Report
W. A. Calhoun and T. E. Hill, Jr. May 1967 43 p refs
(BM-RI-6944)

Progress made in a second and final metallurgical investigation of near-surface Hawaiian bauxitic deposits from Kauai, Maui, and Hawaii Islands, and on a deeper deposit from Kauai, is reported. Previously reported Al_2O_3 extractions were increased by modifying conventional processes to fit the ore being tested. Increases in Al_2O_3 extraction were: Kauai, from 82.8 to 95.4 percent; Maui, 85.5 to 94.1 percent; and Hawaii, from 79.5 to 86.4 percent. Use of a "caustic-reduction sinter, leaching, and magnetic separation process" for Al_2O_3 extraction also produced an iron concentrate of commercial grade, except for titanium content. No successful method was developed for the recovery of a satisfactory titanium concentrate. Author

N67-27736# Bureau of Mines, College Park, Md. Metallurgy Research Center.
LIME SODA SINTER PROCESS. CORRELATION OF REACTION PRODUCTS WITH EXTRACTABILITY OF ALUMINA FROM ANORTHOSITE
Sarkis G. Ampian Apr. 1967 49 p refs
(BM-RI-6933)

Extraction of alumina was correlated with the sinter and leach products from the lime soda sinter process for anorthosite. The effect of composition and grain size of reactants, time and temperature of sintering, and techniques of sample preparation were investigated. Greater than 90% Al_2O_3 extractions were obtained from dry-mixed minus 200-mesh anorthosite sinter mixes having mole ratios of $CaO/SiO_2 = 1.8$ and $Na_2O/Al_2O_3 = 0.8$. These sinter mixes were briquetted at 15,000 psi and fired between 1200° and 1320°C for 20 to 60 minutes. The sinter phases that contribute to low alumina recovery were determined by X-ray diffractometry, optical microscopy, and electron probe X-ray spectrography. The mechanism of the sintering reaction was investigated by high-temperature X-ray diffractometry. The contrast in the lime soda sinter process for clays and for anorthosites are discussed. Explanations and suggested solutions are presented for problems such as gelation and variable alumina recovery encountered by previous investigations. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N67-26489# Stanford Univ., Calif. Radioscience Lab.
A NEW MODEL FOR "IMPULSIVE" PHENOMENA: APPLICATION TO ATMOSPHERIC-NOISE COMMUNICATION CHANNELS
Harry M. Hall Aug. 1966 179 p refs
(Contracts AF 49(638)-1517; Nonr-225(83); Grants AF-AFOSR-783-65; AF-AFOSR-783-66)
(SEL-66-052; TR-3412-8; TR-7050-7; AD-648650; AFOSR-67-0753) CFSTI: HC $3.00/MF $0.65

The work is concerned with the development and application of an analytical model for atmospheric noise, which is radio noise originating in lightning discharges. The generalized t model resulting from our approach is in good agreement with measured data and describes the received atmospheric noise y(t) as $y(t) = a(t)\,n(t)$, where n(t) is a narrowband gaussian process and a(t) is a slowly varying random process, independent of n(t), that modulates n(t). The detection of known signals in additive generalized t noise is considered, and the receiver that minimizes the probability of error found to be a nonlinear logarithmic-correlator receiver. Analytical and experimental results indicate that the probability of error achieved by this receiver in the presence of additive atmospheric noise. Author (TAB)

N67-26583*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN 8 BIT, BIORTHOGONAL TELEMETRY SYSTEM WITH EFFICIENT AND FLEXIBLE SYNC FOR SPACE COMMUNICATIONS
T. V. Saliga Feb. 1967 21 p refs
(NASA-TM-X-55769; X-711-67-76) CFSTI: HC $3.00/MF $0.65
CSCL 09F

An experimental 8 bit, biorthogonal coded telemetry system for deep space applications has been built and evaluated. A carrier coherent telemetering rate sync subsystem provides a precision local clock for the processor so that only a small fraction of power is required for phase offset information. The combined spacecraft, RF modem, tape unit, and processor systems give error probabilities within 1 db of theoretical and reliable sync to less than a 1 decibel ST/No. The sync methods are flexible enough to be applied

to any phase-coherent telemeter. System philosophy and spacecraft hardware are covered here and a companion paper treats the ground data equipment. Author

N67-26615# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
HARMONIC ANALYSIS OF A HALF-WAVE DIPOLE AND DIRECTOR PARALLEL TO A REFLECTING PLANE Interim Technical Report
J. Goldhirsh and P. P. Lombardini Griffiss AFB, N. Y., RADC. Feb. 1967 37 p refs
(Contract AF 30(602)-3290)
(ITR-4; Rept.-67-12; RADC-TR-67-1; AD-648718) CFSTI: HC $3.00/MF $0.65

When substantial harmonic power exists at the input of a radiating antenna, a lobe structure will result that may create a substantial interference problem. In addition, the privacy of the radiating source may be severely hampered. These harmonic fields are generally dependent upon: (a) The order of the harmonic relative to the geometry of the antenna. (b) The impedance the higher harmonic 'sees' at the antenna input. (c) The power available at the given harmonic. The purposes of providing a measure of the seriousness of this problem, a harmonic analysis of a particular type of antenna configuration is examined, namely, that of a center-fed, thin half-wave dipole with director parallel to a reflecting plane. The active dipole is assumed lambda sub 0/4 away from the reflecting plane and the director lambda sub 0/8 away from the active dipole. As a criterion to determine the worst case situation, the antenna is assumed matched at each odd harmonic examined, and equal power is assumed fed at the input. The resulting field patterns show: (a) The presence of the director results in the introduction of sidelobes at the fundamental frequency in the azimuthal plane. (b) The presence of the director plays less of a role the higher the harmonic. (c) In the meridian plane the sidelobes become more intense exceeding the forward lobe intensity as the order of the harmonics is increased. (d) In the azimuthal plane, the sidelobe intensity approaches but does not exceed the forward lobe intensity. Author (TAB)

N67-26639*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MONTE CARLO SIMULATION FOR APOLLO Go, No-Go VERIFICATION
Bernard Kaufman Feb. 1967 24 p refs
(NASA-TM-X-55776; X-507-67-61) CFSTI: HC $3.00/MF $0.65
CSCL 09F

The purpose of this Monte Carlo study is to determine the accuracies to which the scalar orbital parameters speed, height and flight path angle can be determined from 60 seconds to ship tracking data. The Apollo Go, No-Go decision is based upon these scalar parameters. Comparisons are included with results obtained by other investigators using different methods. This study shows that speed is very sensitive to the weighting employed, and that speed and flight path angle are sensitive to tracking geometry. Author

N67-26679# Navy Electronics Lab., San Diego, Calif.
AMPLITUDE MEASUREMENT OF NOISE-MASKED PERIODIC WAVEFORMS Research and Development Report, Sep. 1964-Jun. 1966
D. M. Skillman 11 Oct. 1966 42 p refs
(NEL-1409; AD-648040) CFSTI: HC $3.00/MF $0.65

A test set was constructed from standard commercial equipment -- voltage supplies, noise generators, and meters -- for measurement of noise-masked periodic waveforms. Only nonstandard requirement is a relatively inexpensive comparison circuit. The assembly of such a test set is recommended over purchase of limited-use special gear. Individual equipments can be returned to general laboratory use on completion of measurements. Author (TAB)

N67-26746# Boston Univ., Mass.
OBSERVATIONS OF SUB-ELF EMISSIONS IN THE 2-16 Hz FREQUENCY RANGE
Alan H. Katz and Michael D. Papagiannis Oct. 1966 66 p refs
(Contract AF 19(628)-2350)
(SR-3; AFCRL-66-846; AD-648716) CFSTI: HC $3.00/MF $0.65

The spectrum of sub-ELF emissions in the 2-16 Hz frequency range has been observed over a seven month period extending from January, 1966 to July, 1966. The statistical analysis of the data has shown the following characteristic features: No signals are seen during the day, several discrete frequency emissions are seen during the night, signals displaying a slow frequency drift are seen near sunrise, and a strong decrease of the emissions is observed during magnetic storms. A theoretical model is discussed that is in qualitative agreement with the data obtained. The model is based on the storage of hydromagnetic waves in the waveguide which is formed in the F-region due to the minimum of the phase velocity. Author (TAB)

N67-26753# New Mexico State Univ., University Park. Physical Science Lab.
TELEMETRY, COMMAND AND BEACON ANTENNAS FOR VARIOUS AIR FORCE ROCKETS, PROBES AND SATELLITES Final Scientific Report, 1 May 1963-31 Jan. 1967
H. W. Haas and D. G. Henry Jan. 1967 12 p refs
(Contract AF 19(628)-3229)
(PT00500; AFCRL-67-0110; AD-648243) CFSTI: HC $3.00/MF $0.65

A number of measurements were made to improve existing antenna designs and to obtain information on antenna behavior during flight. Precision radiation patterns were run on unit radiators as well as various arrays to more fully evaluate antenna characteristics such as gain and directivity. Effects due to humidity were measured on various antennas by means of a humidity chamber. Aerodynamic heating was simulated by means of a jet engine exhaust. Effects of heating on antenna tuning and mechanical integrity were checked in this manner. Mechanical vibration of various antennas mounted in numerous modes gave valuable information for further mechanical improvement. Vacuum studies for rf breakdown characteristics were also run. The vacuum system is being redesigned and Physical Science Laboratory has furnished a vacuum pump of advanced design and a larger vacuum chamber for use in these tests. Field checkout of special flight antennas was performed at various launch sites. TAB

N67-26807# Postmaster-General's Dept., Melbourne (Australia).
PROTECTION OF TELEPHONE CABLES FROM ATTACK BY INSECTS
G. Flatau [1966] 19 p refs Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7-9 Dec. 1966
(AD-646543) CFSTI: HC $3.00/MF $0.65

As a result of the testing carried out in Australia over the past 15-20 years, an attempt was made to classify cable sheathing materials into four groups, as far as their resistance to insect attack is concerned: (a) Fully resistant materials: steel, brass, copper, aluminum, bronze, polycarbonate, acetals. (b) Highly resistant materials: rigid P.V.C., high density polythene, nylon, PTFE, polyesters. (c) Moderately resistant materials: lead, polypropylene, polyurethane, some natural rubbers, A.B.S. (d) Non-resistant materials: low density polythene, plasticised PVC cellulose acetate butyrate, synthetic rubbers. No general solution for the protection of telephone cables from insects is yet in existence, but present knowledge is now far enough advanced to be able to specify cable sheathing materials which will stand an excellent change of

resisting attack under the most hazardous conditions. The final selection will usually be a compromise between economic and performance factors, and hence a knowledge of the probability of attack in a given area is required, when such decisions are to be made. TAB

N67-26808# Bell Telephone Labs., Inc., Murray Hill, N. J.
MOISTURE PERMEATION AND ITS EFFECT ON COMMUNICATION CABLE
H. W. Friesen and A. S. Windeler 7 Dec. 1966 35 p refs Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7 Dec. 1966
(AD-646528) CFSTI: HC $3.00/MF $0.65

The paper covers certain aspects of the problem of water in buried telephone cables. In the first part of the paper the permeation of water vapor through plastic sheath is discussed and the concept of the permeation time constant is introduced. A permeation pumping mechanism which can accumulate significant amounts of liquid water in buried cables is described. This mechanism depends on air flow rate and temperature changes in pressurized cables. In the second part of the paper the effects of small amounts of water on the capacitance and conductance of polyethylene insulated cable at voice and carrier frequencies are reported. In addition, some estimates are given of the likelihood of conductor cutoff by electrochemical corrosion in wet PIC cable. Finally, the problem of the junction of pressurized PIC and pulp cables is considered and the effect of humid air from the PIC cable on the electrical properties of the pulp cable are reported. Author (TAB)

N67-26817# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MUTUAL COUPLING IN ARRAY ANTENNAS
John L. Allen and Bliss L. Diamond 4 Oct. 1966 65 p refs
(Contract AF 19(628)-5167; ARPA Order 498; Proj. Defender)
(TR-424; ESD-TR-66-443; AD-648153) CFSTI: HC $3.00/MF $0.65

The report summarizes the current level of understanding of the performance of arrays of real radiators. The extent and nature of the effects of mutual coupling (element pattern distortion, element impedance variation with scan angle, and polarization variation with scan angle) in array antennas are investigated for a variety of array geometries and for several types of radiating elements. Both finite and infinite arrays of regularly spaced, uniformly illuminated, and progressively phased elements are considered. The effects of coupling on unequally spaced arrays, arrays with coupled feed networks, and circularly polarized arrays are also discussed. Finally, the results of a study of the effects of coupling on the radiation patterns of multiple-beam optical-type antennas are presented. Although most of the numerical results are based on thin, dipole radiating elements with and without ground planes (the dipole without a ground plane is the exact dual of an array of slots in a ground plane), both theoretical and experimental investigations of the sensitivity of the results to the element type are included. Emphasis is placed on the results of various analyses and their implications to the array designer. The derivations of some of the more important results are briefly outlined, but in most instances, only the relevant conclusions are given. Author (TAB)

N67-26880# Michigan Univ., Ann Arbor. Radiation Lab.
STUDY OF THE SCATTERING BEHAVIOR OF SPHERE WITH AN ARBITRARILY PLACED CIRCUMFERENTIAL SLOT
Seichoong Chang and Thomas B. A. Senior Feb. 1967 63 p refs
(Contract AF 19(628)-2374)
(SR-6; Rept.-5548-6-T; AFCRL-67-0111; AD-648717) CFSTI: HC $3.00/MF $0.65

The electromagnetic scattering behavior of a metallic sphere loaded with a circumferential slot arbitrarily placed with respect to the direction of incidence is studied. Under the assumption that the slot is of small but nonzero width with a constant electric field across it, the analysis for the external fields is exact. Expressions for the scattered far field components, as well as for the total surface field components, are derived and then used to investigate the extent to which the scattering behavior can be controlled by varying the loading admittances and the slot position. An explicit formula for the loading of the zeroth mode to annul the back scattering cross section is derived, and from this the desired loading is obtained by means of a lumped load at the center of a radial cavity backing the slot. In particular, emphasis is placed on the case where the slot is in the plane of incidence and normal to the direction of the incident electric vector. The numerical study is limited to the frequency range $0 < ka < 3.0$, where a is the radius of the sphere, and results are presented primarily for back scattering. To verify some of these results, a comparison is made with experimental data obtained using a metallic sphere with an equatorial slot backed by a radial cavity of adjustable depth. Author (TAB)

N67-26884# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
ELECTROMAGNETIC INTERFERENCE MEASUREMENT METHODS-SHIELDED ENCLOSURE Quarterly Report No. 1, 1 Jun.–31 Aug. 1966
William R. Free, Charlton H. Bonham, Robert E. Gibson, John H. Gutzke, and Bernard M. Jenkins Jan. 1967 78 p refs
(Contract DA-28-043-AMC-02381 (E))
(ECOM-02381-1; QR-1; AD-647905) CFSTI: HC $3.00/MF $0.65

Investigations were conducted to develop test techniques and procedures for making radiated measurements in shielded enclosures which can be correlated with open-field measurements. The primary objective of this program is to develop a capability for determining the case radiation and susceptibility characteristics of U.S. Army communication equipments in the controlled environment of a shielded enclosure. A microwave hooded probe antenna was designed, fabricated and evaluated during this period. The evaluation has demonstrated the capability of this probe antenna in performing radiated measurements in a shielded enclosure over the frequency range from 1 to 12 GHz which have very good correlation with measurements made in the open-field. A UHF hooded probe antenna, for use over the frequency range from 200 to 1500 MHz, has been designed and fabricated. This antenna is presently being evaluated. A theoretical and experimental investigation to determine the field distribution within a shielded enclosure at low frequencies is being conducted. The present status of these programs is discussed. A study to develop technically valid procedures and test setups for use in making measurements in shielded enclosures is also being conducted. A description of the study program is presented. Author

N67-26893# Middleton (David), Concord, Mass.
A STATISTICAL THEORY OF REVERBERATION AND SIMILAR FIRST-ORDER SCATTERED FIELDS. I. WAVEFORMS AND THE GENERAL PROCESS
David Middleton Oct. 1966 101 p refs
(Contract Nonr-4883(00))
(AD-648401) CFSTI: HC $3.00/MF $0.65

A theory of reverberation and related first-order scattered fields is developed, based on the assumption of weak inhomogeneities (i.e., primary scattering only), and a consequent representation in terms of Poisson point-processes in space and time. Both surface and volume reverberation are included, separately and together, for general geometries, source and receiver at the same and different locations, and arbitrary transmitting and receiving apertures. A combination of field-and ray-theory is employed to obtain a characteristic scattered waveform, where the inhomogeneous medium is replaced by a homogeneous and isotropic one in which a spatially and temporally random ensemble of point scatterers is embedded. The effects of the scattering mechanism are described generally by a linear, time-varying filter response. The medium

itself is seen to be dispersive and is represented by a set of linear (non-separable, statistical) space-time operators, by which the signal source and the receiver are coupled to one another, as well as to the point-scatterers. TAB

N67-26896# Harvard Univ., Cambridge, Mass. Cruft Lab.
THE THEORY OF LONG COUPLED ANTENNAS
Trilochan Padhi Nov. 1966 44 p refs With summary
(Contract Nonr-1866(26))
(NR-371-015; TR-511; AD-648498) CFSTI: HC $3.00/MF $0.65

The self and mutual admittances of an array of two long, thin, identical dipole antennas have been determined by an approximate method based on the Wiener-Hopf technique when the antennas are center driven, parallel and non-staggered. The results have been found in a form suitable for the calculation of the transient response. They may also be used with little modification to obtain the response of an array of three identical dipole antennas located at the corners of an equilateral triangle. Author (TAB)

N67-26908# New Mexico State Univ., Las Cruces. Physical Science Lab.
DESIGN AND TEST OF MODEL 23.010136.5 MHz ANTENNA FOR NIRO AF 7.618
H. W. Haas and D. G. Henry Nov. 1966 35 p ref
(Contract AF 19(628)-3229)
(AFCRL-67-0083; PD00494; SR-7; AD-648240) CFSTI: HC $3.00/MF $0.65

A NIRO rocket to be fired in Alaska required a 136.53 MHz antenna so that the Minitrack installation could be utilized during the flight. The Model 23.010 Spike antenna was designed for this purpose. Impedance, bandwidth and radiation patterns of this antenna are presented. Author (TAB)

N67-26915# Defense Electronics, Inc., Rockville, Md.
ADVANCED DIGITAL FM-PM DEMODULATOR ADD-15 ***Final Report***
William H. Casson Bedford, Mass., Elec. Systems Div., Sep. 1966 123 p refs
(Contract AF 19(628)-5667)
(ESD-TR-66-516; AD-648813) CFSTI: HC $3.00/MF $0.65

The objective of this program is to design, fabricate, and evaluate an advanced FM-PM demodulator for telemetry applications. The unit utilizes new circuit techniques which show definite promise of providing improved performance, particularly in the areas of threshold and linearity. The compromises and limitations involved in the new techniques are thoroughly investigated and the program includes a comprehensive series of tests. Author (TAB)

N67-26939# Harvard Univ., Cambridge, Mass. Cruft Lab.
ARRAYS OF UNEQUAL AND UNEQUALLY-SPACED DIPOLES WITH APPLICATION TO THE LOG-PERIODIC ANTENNA Interim Scientific Report
Weng-Meng Cheong Dec. 1966 299 p refs
(Contract AF 19(628)-2406; Grant NSF GK-273)
(AFCRL-67-0036; SR-14; AD-648450) CFSTI: HC $3.00/MF $0.65

Curtain arrays involving dipoles of both unequal heights and with unequal spacings are examined. Theoretical values are computed using a modified three-term current theory in which the method of driving-point fitting is replaced by that of three-point fitting. A new experimental technique is developed for measuring the self- and mutual admittances of the dipole elements in the curtain arrays. The theory is then used for computing the characteristics of a five-element log-periodic dipole antenna. Accurate measurements are also made with an equivalent model using a coaxial-line feeding arrangement. Finally, a twelve element L-P dipole antenna is critically examined using the theory. Some very interesting and important basic properties of the L-P antennas are brought into light. The performances of the L-P dipole antennas can be clearly demonstrated in terms of the basic properties. Author (TAB)

N67-27005# Signatron, Inc., Lexington, Mass.
STATISTICAL DELTA MODULATION Final Report, 7 Sep. 1965–7 Sep. 1966
Phillip A. Bello, Richard N. Lincoln, and Herbert Gish 31 Oct. 1966 45 p refs
(Contract AF 19(628)-5539)
(AFCRL-66-749; AD-648589) CFSTI: HC $3.00/MF $0.65

The report describes the results of a study of Statistical Delta Modulation (SDM) a new method of digital transmission of analog information. In this method the system design is tailored to the statistical properties of the input data so as to provide analog reconstruction values with a minimum mean squared error. The method of system design is an iterative procedure in which conditional means are evaluated based upon actual input data. The report presents the theory of operation of the system and describes the results of a computer simulation in which such questions as the effects of sampling rate, channel noise, system memory, and mismatched input processes are discussed. Due to time limitations only a brief comparison was made with conventional techniques. It was found that at low sampling rates and for a second order Gaussian Markoff process, sampling rate reductions of 38% could be achieved relative to a conventional delta modulation system at the same SNR performance. Author (TAB)

N67-27045# Communication Systems, Inc., Paramus, N. J.
WIDEBAND DIGITAL MODULATION AND DETECTION TECHNIQUES FOR TROPOSCATTER Quarterly Report, 1 Oct.–31 Dec. 1966
E. Levine, R. T. Adams, P. Grobert, and J. Wolf Mar. 1967 32 p refs
(Contract DA-28-043-AMC-02542(E))
(CSI-67-TR-2342; ECOM-02542-2; QR-2; Rept.-2; AD-648952) CFSTI: HC $3.00/MF $0.65

The objective is to identify and breadboard the modulation technique offering best performance for transmission of high digital data rates over tactical troposcatter paths of 50 to 150 miles at 5 ghz. The study is concerned with higher order modulation coding, in-band diversity and other techniques that may bring about an optimal match to the medium. During this quarter the work was redirected to emphasize operation at data rates of 1.15 and 0.576 megabits per second (mbps) rather than 2.3 mbps. Carrier-to-noise ratios and error probabilities calculated for the existing modulation method show that thermal noise as well as multipath limit performance for path lengths of 100 to 150 miles. This, along with considerations of equipment simplicity and reliability, ease of synchronization, etc. resulted in the choice of a four-frequency, four-phase modulation pattern with in-band diversity for 0.576 and 1.15 mbps operation (12 and 24 channels). A similar modulation pattern without in-band diversity was chosen for 2.3 mbps operation (48 channels). Preliminary calculations indicate that these modulation patterns will result in approximately 10 db signal-to-thermal noise advantage over the existing dual diversity system at error rates of 0.00001 for 0.576 and 1.15 mpbs operation, and approximately 4 db improvement for 2.3 mbps operation. Author (TAB)

N67-27050# Environmental Science Services Administration, Boulder, Colo. Institutes for Environmental Research.
TABLES AND GRAPHS OF EIGENVALUES FOR LAYERED-GROUND PROPAGATION
L. E. Vogler and J. L. Noble Nov. 1966 54 p refs
(IER-5-ITSA-5; PB-173811) CFSTI: HC $3.00/MF $0.65

This paper presents tables and graphs of the roots τ_s of the height gain differential equation arising from the problem of

radio diffraction over a sphere: $h_2(-2^{1/3}\tau_s)/h_2'(-2^{1/3}\tau_s)=2^{1/3}K\exp[-i(135°-b/2)]$, where $h_2(z)$ is the modified Hankel function. The first three roots are calculated for b ranging from +90° to −90° at 10° intervals and for K ranging from 0 to ∞; the first nine roots are given for b=+90°, 0°, and −90°. A discussion is included which explains the use of τ_s in the calculation of diffraction fields over either layered or non-layered grounds. Author

N67-27098*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
STATISTICAL COMMUNICATION THEORY
In its Res. Lab. of Electron. 15 Apr. 1967 p 231–238 refs (See N67-27081 14-23)
(Contract DA-28-043-AMC-02536(E))

In a statistical communication theory, a discrete analysis of homomorphic deconvolutions is presented briefly. Consideration is given to the characterization of the system when all of the signals are discrete time functions. In a study of unity feedback two-state modulator configurations, equations are derived for the dynamic ramp response, and the frequency response of the modulator, inferred from the ramp response. In the case of a continuous amplifier with feedback, this is the inverse of the feedback network response. Brief analytical data are presented on error term, a typical input to the threshold device, the error waveform, static input, and the integral two-state modulation system. R.Ll.

N67-27099*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PROCESSING AND TRANSMISSION OF INFORMATION
In its Res. Lab. of Electron. 15 Apr. 1967 p 239–248 refs (See N67-27081 14-23)
(Contract DA-28-043-AMC-02536(E))

In application to a general study on information transmission, a linear feedback shift-register (FSR) is considered. It is completely described by its length and its connection polynomial, as well as the schematic presented. A rate distortion curve for source forms part of a communication channel investigation. It is assumed that both the source and channel are discrete, constant, and memoryless, and that the channel is available for use at a rate of once per source output. R.Ll.

N67-27101*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
SPEECH COMMUNICATION
In its Res. Lab. of Electron. 15 Apr. 1967 p 267–277 refs (See N67-27081 14-23)
(Contract AF 19(628)-5661; Grant NIH NB-04332-04)

Linguistic theory for speech communication application is considered. Brief details are presented on the mechanism of glottal vibration for vowels and consonants, and on homomorphic speech processing. R.Ll.

N67-27103*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
COGNITIVE INFORMATION PROCESSING
In its Res. Lab. of Electron. 15 Apr. 1967 p 305–320 refs (See N67-27081 14-23)
(Contract DA-28-043-AMC-02536(E); Grants NSF GK-835; NIH G-MH-04737-06)

Information acquisition and processing, in relation to communication theory, is discussed in linguistic terms within the framework of electronic developments. Some areas covered briefly are: acquired asymmetry of shape learning, transmission and coding of color pictures, subjective effects of white pictorial noise with various probability distributions, and stochastic model for weather maps. R.Ll.

N67-27191# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
INTERFERENCE REDUCTION EQUIPMENT, TRANSMITTER FIXES Final Report
William F. Herget and Dominick L. Offi Oct. 1966 40 p refs
(RD-66-59)

Two sets of radar RF filters (S-band and L-band) to reduce radar interference, were tested. Each filter was inserted in the transmission lines. It was found that interfering radiations could be effectively reduced by RF filtering. It was recommended that these filters be installed on FAA radars at field sites where radar interference exists. Author

N67-27203 Joint Publications Research Service, Washington, D. C.
PHASE STABILITY OF THE INTERMEDIATE-FREQUENCY CARRIER IN A RADAR SITE
Tsung-cheng Ch'u 21 Apr. 1967 21 p Transl. into ENGLISH from Wu-Hsien-Tien Chisu (Peking), no. 12, 11 Dec. 1965 p 9–15
(JPRS-40722; TT-67-31365) CFSTI: $3.00

Factors affecting phase instability are examined in terms of frequency stability; interference occurring within the time of the intermediate frequency dominant wave, or in front of or behind it; mechanical vibration sources; and the wave form of external excitation voltage. Two methods for measuring transmitter frequency stability are discussed: the phase discriminator, and the phase comparison techniques. An approximate solution to the nonlinear differential equation of oscillators is presented. In it, the quasi-straight line solution method is used to transform the second order nonlinear differential equations into linear differential equations for analogy with the forced oscillation problems of returns. A conclusion similar to that of the slowly varying oscillation amplitude method is thereby obtained. M.G.J.

N67-27213# Wilcox Electric Co., Inc., Kansas City, Mo.
DEVELOPMENT OF PROTOTYPE DOUBLE SIDEBAND DOPPLER VOR TRANSMITTER AND CARRIER MODULATOR Final Report
Harold G. Boone Dec. 1965 65 p
(Contract FA-WA-4646)
(RD-65-44)

These equipments are for use in a Doppler VOR ground station. The double-sideband transmitter provides two 50 watt outputs, each phase locked to a carrier transmitter at 9960 cps above or below the carrier frequency. Two separate output stages are automatically frequency controlled by a phase control unit to obtain the two sidebands. The carrier modulator replaces the present conventional VOR modulator and extends the modulation capability down to 30 cps. The modulator is driven by an alternator on the Doppler VOR distributor and controls the phase of the 30 cps modulation signal automatically. The transmitter and modulator have been evaluated for performance and the final design has passed type tests. Author

N67-27214# Communication Systems, Inc., Paramus, N. J.
ANALYSIS AND DEFINEMENT OF THE PERFORMANCE CHARACTERISTICS OF TACAN ANTENNAS Final Report
Edward Levine, Nathan Marchand, and Philip Zenchoff Oct. 1966 142 p refs
(Contract FA-66-WA-1411)
(RD-66-91)

The objectives were to analyze and define the performance characteristics of current Tacan antennas, to identify factors in antenna design and environment that limit Tacan system performance, and to recommend means for overcoming or reducing the adverse effects of present ground station antenna design and siting practices. The critical pattern characteristics for all Tacan antennas are pattern slope, and tracking of the carrier and sidebands on

the horizon. For the RTA-2 antenna there is an additional problem of cross polarized radiation. These, together with site reflections and receiver characteristics, are the principal limiting factors identified. The most promising techniques for improving performance at problem sites are (1) to increase the antenna height to 70 feet or greater or (2) to employ a space diversity technique that uses the existing ground installation and a second antenna. Author

N67-27255 Signals Research and Development Establishment, Christchurch (England).
OPTIMUM PARABOLOID AERIAL DESIGN
D. Herbison-Evans Sep. 1966 22 p refs
(Rept.-66012)

A computer study was made of the spillover, cross polarization, and illumination efficiency of paraboloids of various F/D ratios (focal length/paraboloid diameter) fed by rectangular, square and circular waveguides in their lowest order modes. The feed radiation patterns used were those derived by simple diffraction theory, from the incident waveguide-mode field distribution. The approximations made in this derivation give unnaturally low spillover for very small aperture feeds and thus favor Short F/D systems which would use such feeds. The feed dimensions were optimized to give maximum merit (gain/total noise temperature) for each combination of feed, receiver noise temperature and F/D ratio. The optimum horn dimensions and resulting illumination tapers, excess aerial noise temperatures, gain efficiencies and merit, produced by the computations are presented. The results show among other things that the merit of a low F/D system is about 0.8 dB less than that of a large F/D system. Author

N67-27260# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhoffen (West Germany). Institut fuer Flugfunk und Mikrowellen.
EXTERNAL NOISE AND ANTENNA NOISE TEMPERATURES IN THE 136 AND 400-MHz-SATELLITE-FREQUENCY-BANDS [EXTERNE STOERUNGEN UND ANTENNENRAUSCHTEMPERATUREN BEI SATELLITENBEOBACHTUNGEN IM 136 UND 400-MHz-BEREICH]
Siegfried Starker Feb. 1967 51 p refs In GERMAN; ENGLISH summary Presented at the Symposium "Systemfragen fuer Bodenstationen", Darmstadt, West Germany, 7–8 Oct. 1965
(DLR-FB-67-12; DVL-576) CFSTI: HC $3.00/MF $0.65

The exact formula of the equivalent antenna noise temperature follows directly from Planck's law of thermodynamics. For the practical application of this formula it is necessary to know the distribution of thermal noise in the surroundings of the antenna. This paper gives a survey of the thermal radiation of the galaxy, radiostars, sun, planets, moon, ionosphere, troposhere, and earth in the frequency-bands of 136 and 400 MHz. The data allow to examine the validity of a simplified formula, presented in this paper for the calculation of the antenna temperature. Finally a method is derived based on this simplified formula and the distribution of the galactic noise at 136 and 400 MHz, which gives a good quick-look on the instantaneous temperature of an antenna in dependance of direction and time of observation. Author

N67-27267*# Raytheon Co., Norwood, Mass.
STUDY OF A SIGNAL PROCESS OR EMPLOYING A SYNTHETIC PHASE ISOLATOR
W. J. Bickford, R. G. Cease, D. B. Cooper, and H. J. Rowland Washington, NASA, May 1967 90 p
(Contract NAS12-82)
(NASA-CR-728) CFSTI: HC $3.00 CSCL 09F

This report covers the analytical and experimental investigations pertaining to a signal data processor employing the Raytheon Synthetic Phase Isolator. The study shows analytical justification for considering such a signal processor in an adaptive antenna system. The experimental program demonstrated that the analytical conclusions were achievable, and the desired results were demonstrated by a two-channel processor. The Synthetic Phase Isolator, SPI, is a signal processing technique for combining signals which originated at one point but have travelled slightly different paths in reaching the receiver. If the radio frequency bandwidth is small compared to center frequency and the relative path delays are small compared to the time of one cycle of the highest information frequency, the SPI will perform its function which is that of a predetection combiner. Author

N67-27283*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
LEAST SQUARES ANALYSIS OF UNIFIED S-BAND SYSTEM DATA FROM AS-202
L. Elfenbein 3 Feb. 1967 21 p refs
(NASA-TM-X-55783; X-507-67-53) CFSTI: HC $3.00/MF $0.65 CSCL 09F

A preliminary analysis is presented for the unified S-Band system high speed range rate and X-Y angular data acquired from the Merritt Island and the Bermuda ground stations during the AS-202 mission. The data analyzed were acquired under powered flight conditions. The procedure used in the analysis consisted of fitting polynomials, in the least squares sense, to tracking data over short time intervals. The resulting standard deviations of fit were used as measures of the noise characteristics of the data. Author

N67-27291*# Goodyear Aerospace Corp., Akron, Ohio.
GROUND-BASED PHOTOMETRIC SURVEILLANCE OF THE PASSIVE GEODETIC SATELLITE
R. L. Hostetler, R. H. Emmons, R. J. Preski, C. L. Rogers, and D. C. Romick Washington, NASA, Jun. 1967 107 p refs
(Contract NAS1-6189)
(NASA-CR-791) CFSTI: HC $3.00 CSCL 17H

The PAGEOS I (Passive Geodetic Earth Orbiting Satellite) satellite was observed during the first 60 days of its orbital life by ground-based photometry using a 24-inch telescope mounted in a mobile observatory. It appears that the combined environmental factors at the PAGEOS I orbital height caused no measurable degradation in the first two months following deployment. Fifty-two PAGEOS I passes were observed, with 45 in three-color photometry and 7 in single-color. Half of the more than 5000 data points measured were in the U-band, and 25% each in the B-band and the V-band. Raw data were reduced to obtain satellite stellar magnitude, solar reflectance, specular component of reflected light, and radius of curvature and its local variance. Data reduction including digitizing the analog data of satellite or star intensity and time. Theory of photometric observations of a satellite is discussed, and operation procedures from pass acquitition through data analysis are presented. M.W.R.

N67-27292*# Hughes Aircraft Co., Fullerton, Calif.
EXPERIMENTAL CASSEGRAIN-FED MONOPULSE ANTENNA SYSTEM
R. T. Clark and P. A. Jensen Washington, NASA, May 1967 146 p
(Contract NAS5-9880)
(NASA-CR-720) CSCL 09F

The purpose of this program was to design a five horn monopulse feed with ultimate capability of high efficiency and low noise preformance at both 6 and 4 GHz when utilized in a Cassegrain antenna. The program covered feed component design, fabrication of a feed capable of operation of 4 GHz, and design and assembly of a 15-foot Cassegrain antenna using a dish supplied by NASA. Detailed primary and secondary measurements were made to evaluate the feed performance. A technique of making five horn feeds was developed. A feed capable of providing greater than 50% efficiency at both 6 and 4 GHz, monopulse tracking at 4 GHz, and low antenna noise temperature was

developed. It is recommended that this approach be used to design a feed capable of operation at both 6 and 4 GHz, and evaluated in a 30 foot diameter or larger Cassegrain antenna. Author

N67-27353# Joint Publications Research Service, Washington, D. C.

INFLUENCE OF THE EARTH'S MAGNETIC FIELD ON A BACKSCATTERED SIGNAL

Yu. A. Chernov 14 Mar. 1967 15 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 6, no. 5, 1966 p 881–888

(JPRS-40256; TT-67-30902) CFSTI: HC $3.00/MF $0.65

It is demonstrated that in nighttime sounding by the backscattering method the level of the extraordinary component is approximately equal to the ordinary component. In the daytime, when there is a predominance of undeflected absorption, the ordinary component exceeds the extraordinary component. The conclusion is drawn from the analysis that if absorption Γ in one direction does not exceed 1.5 and the signal-to-noise ratio >0.2 the leading edge of the signal corresponds to a lag of the extraordinary component. Author

N67-27359# Joint Publications Research Service, Washington, D. C.

METHOD OF OBSERVING AND INTERPRETING THE RESULTS OF STUDYING THE FIELDS OF RADIO BROADCASTING STATIONS

A. V. Veshev and V. A. Yegorov 19 Apr. 1967 21 p refs Transl. into ENGLISH from Vch. Zap. Leningr. Gos. Univ. (Leningrad), no. 329, 1966 p 172–189

(JPRS-40704; TT-67-31347) CFSTI: HC $3.00/MF $0.65

The possibilities of the radio-kipp method, based on the study of amplitude waves of the separate components of an electromagnetic field, in solving various geological problems are discussed. It is pointed out that the possibilities of using the fields of radio broadcasting stations may be increased if the results of the observations are represented in the form of effective resistance $\tilde{\rho}$ and effective dielectric constant. Applications of the method of radioelectromagnetic profiling (Rep), in which a single selected frequency of the electromagnetic field is used, are discussed. The following conclusions were drawn from the study: (1) The surface impedance and the angle of inclination of the wavefront of the fields of the radio broadcasting stations may be used for determining the electrical properties of rocks. (2) With rocks of relatively low resistivity the measurements for determining $\tilde{\rho}$ may be limited to amplitude measurements. (3) The curves of in Rep have a greater resolving power than the curves of the horizontal component of a magnetic field studied in the radio-kipp method. L.E.W.

N67-27366*# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.

AN EXPERIMENTAL STUDY OF IMPERFECTLY CONDUCTING DIPOLES

Liang-Chi Shen Mar. 1967 21 p refs

(Grant NsG-579)

(NASA-CR-84407; SR-8) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Input admittances of dipole antennas with moderately high internal impedance were measured in the UHF range with the antenna lengths varying from 1/10-wavelength to such a value that the antenna behaved as if infinitely long. The measured results are compared with the three-term theory of King and Wu and with the theoretical values obtained by Shen and Wu for an infinitely long antenna. Author

N67-27393 Joint Publications Research Service, Washington, D. C.

PRINCIPLES OF RADIO DIRECTION FINDING

I. S. Kukes and M. Ye. Stark 14 Mar. 1967 536 p refs Transl. into ENGLISH of the book "Osnovy Radiopelengatsii" Moscow, 1962 p 1–640

(JPRS-40258; TT-67-30904) CFSTI: HC $3.00

Methods for designing a radio directional finder (RDF), and its elements are given; and errors incurred in direction finding with methods for their elimination, are analyzed. Signal-to-noise power ratios at various parts of the elements; sensitivity of the finder; polarization effects on the radio wave propagation; and effects of locality and environment on the finder system are discussed. Various RDF antenna systems are described, and the design of antenna systems for RDF's are discussed. Various applications of RDF systems are presented. L.S.

N67-27395 Joint Publications Research Service, Washington, D. C.

NOISE-REJECTION CODING OF DIGITAL TELETYPE COMMUNICATIONS IN COMPLEX AUTOMATIC HYDROMETEOROLOGICAL TELEMETERING SYSTEMS

V. P. Petrov and A. N. Radchenko 7 Apr. 1967 31 p refs Transl. into ENGLISH from Primeneniye Avtom., Radioelektroniki i Yadernykh Izlucheniy Pri Gidrolog., no. 130, 1966 p 98–121

(JPRS-40557; TT-67-31201) CFSTI: $3.00

Mathematical methods and circuitry devices for correcting errors in the noise rejection coding are examined. The devices afford protection from more than 35 burst type noises. A specific problem in correcting bursts in a start-stop code is investigated. Diagrams of the various circuit network devices used in the communications channels are depicted. L.S.

N67-27401*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

CONFERENCE ON ADAPTIVE TELEMETRY

Jan. 1967 225 p refs Conf. held at Greenbelt, Md., 15–16 Feb. 1966

(NASA-TM-X-55747; X-731-67-7) CFSTI: HC $3.00/MF $0.65 CSCL 09F

CONTENTS:

1. SPACE EXPLORATION'S CHALLENGE TO ADAPTIVE TELEMETRY p 3–6 (See N67-27402 14-07)

2. ADAPTIVE METHODS IN COMMUNICATION SYSTEMS A. V. Balakrishnan (Calif. Univ.) p 9–25 refs (See N67-27403 14-07)

3. ADAPTIVE PREDICTION OF TIME SERIES L. D. Davisson (Princeton Univ.) p 27–39 refs (See N67-27404 14-07)

4. RESULTS OF ADAPTIVE PREDICTOR STUDIES, PART 1 R. L. Kutz p 41–53 refs (See N67-27405 14-07)

5. DEMONSTRATION OF A QUANTILE SYSTEM FOR COMPRESSION OF DATA FROM DEEP SPACE PROBES T. O. Anderson, I. Eisenberger, W. A. Lushbaugh, and E. C. Posner (JPL) p 55–73 refs (See N67-27406 14-07)

6. A STUDY OF DATA COMPRESSION BUFFERING R. Hollenbaugh p 77–79 (See N67-27407 14-07)

7. RESULTS OF ADAPTIVE PREDICTOR STUDIES, II J. A. Sciulli p 81–108 refs (See N67-27408 14-07)

8. DATA COMPACTION STUDIES C. R. Laughlin p 109–114 (See N67-27409 14-07)

9. A PARAMETER EXTRACTION TECHNIQUE J. W. Snively, Jr. p 117–127 refs (See N67-27410 14-07)

10. USE OF A STORED-PROGRAM COMPUTER ON A SMALL SPACECRAFT R. A. Cliff p 129–133 refs (See N67-27411 14-08)

11. UNIFIED INFORMATION PROCESSING TELEMETRY SYSTEM C. J. Creveling p 135–140 (See N67-27412 14-07)

12. CHANNEL NOISE—A LIMITING FACTOR ON THE PERFORMANCE OF A CLASS OF ADAPTIVE TECHNIQUES G. L. Raga (Electro-Mechanical Res., Inc.) p 143–169 refs (See N67-27413 14-07)

13. ELIMINATING REDUNDANCY IN FIXED FRAME TELEVISION L. W. Gardenhire (Radiation, Inc.) p 171–187 (See N67-27414 14-07)

N67-27402# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACE EXPLORATION'S CHALLENGE TO ADAPTIVE TELEMETRY
In its Conf. on Adaptive Telemetry Jan. 1966 p 3–6 (See N67-27401 14-07)

The more subtle advantages of adaptive techniques as they apply to virtually every future space program are discussed in relation to the need for transmitting only the most meaningful information. Three operations which can be required to delineate a more restricted as well as a more important class of adaptive telemetry systems are identified. These are (1) monitoring the system performance by measurements against given performance criteria and relating these measurements to certain system parameters, (2) learning or estimating the states of certain channel parameters and evaluating the quality of the received information; and (3) modifying or adjusting parameters to optimize the receiver structure as instructed through the learning process. It is pointed out that the adaptive procedures may be applied at the transmitter location, in which case encoding equipment may be adapted to accommodate the changes in the data source. Alternately, they may be applied at the receiver location, and decision functions may be adapted to accommodate changes in the transmitter operation or in the transmission medium. M.G.J.

N67-27403*# California Univ., Los Angeles.
ADAPTIVE METHODS IN COMMUNICATION SYSTEMS
A. V. Balakrishnan *In* NASA. Goddard Space Flight Center Conf. on Adaptive Telemetry Jan. 1967 p 9–25 refs (See N67-27401 14-07)

The discussion centers on the optimization theory for adaptive systems that involve the transmission and/or reception of information. After examining the features that define adaptivity, three specific applications are discussed: the adaptive feature in the transmitter, that in the receiver, and that in both receiver and transmitter. In the first case, a PCM transmitter is designed to minimize average transmitter power directly by adapting it to the probable state. The second application is a diversity receiver which seeks to minimize error by adapting to various signal strengths. The third is an adaptive data compression system that exploits data redundancy by utilizing an adaptive data predictor; the band-width reduction is initiated only if the data warrant it. These examples also serve to illustrate the problems that still remain before a general theory of adaptive optimization can evolve. One of the main difficulties is cited as the quantitative evaluation of adaptive systems. Author

N67-27404*# Princeton Univ., N. J.
ADAPTIVE PREDICTION OF TIME SERIES
L. D. Davisson *In* NASA. Goddard Space Flight Center Conf. on Adaptive Telemetry Jan. 1967 p 27–39 refs (See N67-27401 14-07)

A procedure is described for estimating the mean square prediction error for stationary Gaussian time series of unknown covariance. An estimation is made of σ^2 [M,N], where M is the memory and N (learning period) is the number of predictions used in calculating the sample mean square error. Based on the data used, it is pointed out that the fitting error is a poor estimate since it is monotonic and decreases with M even though σ^2 [M,N] is not monotonic. However, an appropriately weighted function of the fitting error can be used. With this estimate, it is then possible to specify the best value of M for fixed values of N, and to specify a value of N so that the factor σ^2 [M,N]/σ^2 [∞,∞] is sufficiently small. The values of M/N considered are intermediate in the sense that terms of o(M/N) in asymptotic expansions can be neglected whereas the M/N term cannot. The equations are derived, and the results of computer simulations to verify the effectiveness of the procedure are presented. M.G.J.

N67-27405*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESULTS OF ADAPTIVE PREDICTOR STUDIES, PART 1
R. L. Kutz *In its* Conf. on Adaptive Telemetry Jan. 1967 p 41–53 refs (See N67-27401 14-07)

Video data taken from the fifth picture in a series of ten Tiros cloud pictures are used as a basis for discussing the relative merits of linear and Markov prediction data compression techniques. Also discussed are the steepest descent and conjugate methods of solving the simultaneous equations to determine the minimum mean square error weights. It was concluded: (1) When using linear prediction, higher compression ratios can be achieved by learning from data for which prediction has been attempted. A memory of 3 gives slightly better results than a memory of 1, but the difference is negligible. (2) The zero-order hold is considered the best of the linear predictors. (3) If nonlinear terms are introduced as with parameter D=2, the compression ratios are lower than with D=1 using linear prediction. (4) The Markov predictor performs better than the linear predictors probably because of its optimality for all data amplitudes. M.G.J.

N67-27406*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEMONSTRATION OF A QUANTILE SYSTEM FOR COMPRESSION OF DATA FROM DEEP SPACE PROBES
T. O. Anderson, I. Eisenberger, W. A. Lushbaugh, and E. C. Posner *In* NASA. Goddard Space Flight Center Conf. on Adaptive Telemetry Jan. 1967 p 55–73 refs (See N67-27401 14-07)

A method effecting data compression is described, which involves transmitting a small number of sample quantiles (instead of all of the sample values) and extracting the desired statistical information. It is shown that by using quantiles a significant amount of data compression can be achieved, and the reduction in uncertainty which accompanies a large sample size is retained. Data compression ratios are discussed, and an extremely simple quantiler design in which no arithmetic operations are performed is introduced. A particle count experiment is used as an example, with the data grouped into a histogram before the quantiles are determined. A block diagram of a prototype quantiler and associated input–output test equipment is depicted. Tests were performed to determine the mean and standard deviation of known distributions by sampling and computing these parameters from the observed quantities. Results show excellent agreement between the observed and the theoretical values. M.G.J.

N67-27407*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A STUDY OF DATA COMPRESSION BUFFERING
R. Hollenbaugh *In its* Conf. on Adaptive Telemetry Jan. 1967 p 77–79 (See N67-27401 14-07)

A system which uses a buffer memory for rate interfacing is described. Two control lines originating from the buffer prevent buffer overflow and buffer emptying. An inhibit control sets the source rate to zero when the buffer memory is full; a demand control assures that the buffer does not empty before the source is exhausted. Two specific cases of redundancy distribution are analyzed. The controlled rate source is a TV camera with 1000 lines and 1000 elements per line; each element requires six information bits to encode it. System variables are defined as TV scan rate in lines per second; bits required to encode one line of TV data before and after compression; increase in scan rate for data compression operation; and buffer size, in bits. The read-in rate of the recorder is defined in terms of the system parameters. It was determined that the effect of the buffer size is appreciable only for cases of high compression ratios. It was also found that

the increase in scan rate influences system operation, and that the buffer size can be much smaller than the picture and still perform effectively. M.G.J.

N67-27408*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESULTS OF ADAPTIVE PREDICTOR STUDIES, II
J. A. Sciulli *In its* Conf. on Adaptive Telemetry Jan. 1967 p 81–108 refs (See N67-27401 14-07)

The application of the conditional expectation predictor to the compression of video data is discussed, and computer simulation using Tiros TV cloud-cover picture data as the information source is described. The characteristics of the prediction mechanism with element compression ratio as the standard of comparison are defined, and some possible approaches to the coding problem using bit compression ratio as the comparison standard are assessed. It was found that the conditional expectation predictor produced compression ratios significantly greater than either the zero-order hold or the linear predictors. This result held true for each of the 10 TV frames used and is considered significant since it shows that the conditional expectation predictor yields superior compression ratios despite the suspected nonstationary character of the information source. In summarizing the numerical results, it is noted that the predictor produced bit compression ratios exceeding 5:1 on a number of single TV frames. M.G.J.

N67-27409*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA COMPACTION STUDIES
C. R. Laughlin *In its* Conf. on Adaptive Telemetry Jan. 1967 p 109–114 (See N67-27401 14-07)

Techniques for reducing the channel capacity requirements for real time digital transmission of imagery signals are reviewed, and various approaches to designing a predictor are examined. The need of devising an efficient coding scheme for representing the compressed signal is stressed, and a new approach to the problem is described. The system comprises a highly efficient coding scheme which is practical to instrument, and a digital scan camera which produces a variable rate source and reduces buffer requirements. The camera scans a line at a time at an element-per-second rate equal to the bit transmission rate. The predictor also operates at this rate and stores the value of each unpredictable element in the Q store. At the same time, the T-register is loaded with a sequence of prediction success indicator digits which represent the position of each unpredictable (or predictable) element in the line. This sequence is fed directly to the R-register for transmission to the channel. At the completion of the T readout, the camera scan is stopped at the end of the given line while the Q store is fed to the R-register for transmission. The readout control is an electronic commutator which formats the output sequence. M.G.J.

N67-27410*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PARAMETER EXTRACTION TECHNIQUE
J. W. Snively, Jr. *In its* Conf. on Adaptive Telemetry Jan. 1967 p 117–127 refs (See N67-27401 14-07)

A parameter extraction technique is described which is applicable to data displayed in histogram form. An algebraic approach is taken since calculated upper and lower bounds on the magnitude of the desired quantities are used rather than confidence levels or hypothesis tests. The technique has been implemented into flight hardware as part of a plasma measuring experiment to be flown on two Interplanetary Monitor Platform (IMP) flights. The relationship between the area and the sum of squares for a histogram of 16 bars is discussed and depicted. Theoretically, it is assumed that the area and the sum of the squares are known exactly and the consequences of such conditions are discussed. The consequences obtained also may be applied to cases where the area and the sum of the squares are not known exactly. It is shown that transmission of the area of a histogram and certain bits of the sum of the squares permits much of the original histogram to be recovered. M.G.J.

N67-27412*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UNIFIED INFORMATION PROCESSING TELEMETRY SYSTEM
C. J. Creveling *In its* Conf. on Adaptive Telemetry Jan. 1967 p 135–140 (See N67-27401 14-07)

The multidisciplinary approach which must be considered in order to achieve a unified information processing telemetry system is discussed in terms of the increasing number of people who become involved in the design as system complexity increases. Consideration is also given to the differences existing between a microprogrammed machine and a stored program computer. In the microprogrammed machine variable word length can be provided inexpensively; microprograms and macroprograms are stored and are changeable. The conventional computer is characterized by fixed input format and fixed word length; has a fixed logic structure, a stored program, and a fixed instruction repertoire that can be set up on the ground. Flexibility is provided by software, and the capability for simultaneous operations is limited. Usually a large stored program memory is required. The microprogrammed computer, however, circumvents many of these limitations and its instructions, in effect, rewire the machine for the problem at hand. M.G.J.

N67-27413*# Electro-Mechanical Research, Inc., Sarasota, Fla.
CHANNEL NOISE—A LIMITING FACTOR ON THE PERFORMANCE OF A CLASS OF ADAPTIVE TECHNIQUES
G. L. Raga *In* NASA. Goddard Space Flight Center Conf. on Adaptive Telemetry Jan. 1967 p 143–169 refs (See N67-27401 14-07)

From the available literature it appears that the majority of the users of telemetry compressions are considering the zero-order interpolator. An unfortunate discrepancy exists in the terminology in that the zero-order interpolator is frequently described as a zero-order predictor, self-adaptive compression, an adaptive sampling technique, selective monitoring, run-length encoding, floating aperture, redundancy removal, and the step method. These techniques operate identically, and can be applied to a television source. For the purposes of illustration, the source will be considered a television source. Start with word 1, line 1, of a television frame. Word 1 is compared with word 2; if the absolute value of the difference is less than K, word 2 is disregarded and the process continues until the difference is greater than K, say at word j. At this point, word 1 is transmitted to a buffer store along with the distance from word 1 to word j. Word j then replaces word 1 and is used as a basis, and the process continues. It is this class of adaptive techniques that is investigated. Author

N67-27414*# Radiation, Inc., Melbourne, Fla.
ELIMINATING REDUNDANCY IN FIXED FRAME TELEVISION
L. W. Gardenhire *In* NASA. Goddard Space Flight Center Conf. on Adaptive Telemetry Jan. 1967 p 171–187 (See N67-27401 14-07)

The importance of recognizing the basic information content of the data to be sampled is emphasized, along with the direct relationship existing between the spectral characteristics of the original sampled waveform and the interpolation error created by the method used to reconstruct the data. It is pointed out that the real criterion for judging the results of redundancy reduction processes on television pictures is not compression ratio, but the minimum number of bits necessary to transmit a picture of a given quality. Two different problems that exist in transmitting pictures are discussed. One occurs when it is important to reduce power and

not necessarily bandwidth, which is most likely in the case of satellites; the other, where it is important to reduce bandwidth and not necessarily power, such as for transmission over existing ground stations. Redundancy studies, performed with a Data Management Analyzer, are also reported. M.G.J.

N67-27427*# ADCOM, Inc., Cambridge, Mass.
PART I: APPLICATION OF ULTRA-STABLE OSCILLATORS TO ONE WAY RANGING SYSTEMS. PART II: FLUCTUATION SPECTRA OF ULTRA-STABLE OSCILLATORS: MEASUREMENT AND ESTIMATION Final Report
Ahmad F. Ghais, John H. Miller, and Howard C. Salwen 30 Jan. 1967 129 p refs
(Contract NAS5-9705)
(NASA-CR-84444) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The feasibility of designing a one-way or passive ranging system given the fact that a spacecraft oscillator is highly stable and its frequency is well known is determined. The basic techniques of trajectory measurement in a one-way tracking system are described, and the effects of lack of coherence between transmitter and receiver on system operation and accuracy are analyzed. It is found that one-way tracking techniques are quite sensitive to geometric dilution of precision, and explorations of these geometrical problems are shown. The development of a measurement technique for determining in the frequency domain the phase fluctuation spectrum of highly stable oscillators is discussed. Specific recommendations on the use of some techniques to extract the fluctuations of ultrastable oscillators are made, and mathematical techniques for spectral estimation are presented in detail. The foundations leading to the computational procedures are shown, and conclusions and recommendations on the use of these procedures are drawn. C.T.C.

N67-27483# Hughes Aircraft Co., Culver City, Calif. Antenna Dept.
ANGULAR RESOLUTION BEYOND THE RAYLEIGH LIMIT
A. A. Ksienski and R. B. McGhee Dec. 1966 48 p refs
(Contract AF 19(628)-4358)
(P67-3; AFCRL-67-0061; SR-1; AD-648079) CFSTI: HC $3.00/MF $0.65

The problem of angular resolution is formulated in a statistical decision theoretic context. A tutorial discussion of decision theory and its application to resolution is presented, and an explicit signal processing radar system is derived whose resolving properties approach an optimum. Computer simulation tests show that the system is capable of reliably resolving targets as close as a quarter of a 3-db beamwidth in the presence of noise and system errors. Author (TAB)

N67-27470# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
RECORDING AND DISPLAY OF REDUCED BANDWIDTH TV SIGNALS
Philip Balaban Nov. 1966 127 p refs
(Contracts AF 49(638)-1402; AF 19(628)-3815)
(PIBMRI-1356-66; AFOSR-67-0148; AD-648225) CFSTI: HC $3.00/MF $0.65

The report is composed of three sections: The first section deals with Bandwidth reduction of television signals using pseudo-random scanning. The effect of different disturbances encountered in a transmission channel are evaluated. In section II a system is described that was developed to record the pseudo-random scanned television signals. The system is capable of recording 200 kHz signals on a 1/4 inch tape running at 15 ips. The system employs unique skew and flutter compensation. A 61.44 kHz experimental recording system is described. The distortion of a pseudo-random scanned TV signal caused by flutter and skew introduced by the tape recording is analyzed theoretically. Specifically the signal-to-noise ratio is computed for a typical system, assuming the distortion can be considered to be additive random noise. In section III the bandwidth reduction for extremely slow frame rates is evaluated experimentally. A scan conversion apparatus was built to provide the necessary long storage of the image. Author (TAB)

N67-27614*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA COMPRESSION WITH ERROR-CONTROL CODING FOR SPACE TELEMETRY
Thomas J. Lynch Washington, NASA, Jun. 1967 82 p refs
(NASA-TR-R-261) CFSTI: HC $3.00 CSCL 09F

The considerations involved in combining data compression and error control coding in space telemetry are analyzed through the use of two performance measures which are similar to those measures used for *rate distortion function*. The average distortion is a function of the source probability distribution, the overall system transitional probability matrix, and a cost matrix which signifies the relative importance of different types of data errors. The rate-ratio is the reciprocal of the overall system compression ratio and includes the data expansion effect of additional timing data, identification data, and coding redundancy. Different schemes for supplying the timing information in a compressed system are analyzed and compared. A new timing scheme is developed which requires, on the average, fewer time words for a large class of data sources. A method is developed for uniquely encoding and decoding an entire sequence of time words for compressed data, utilizing the strict monotonicity of the sequence. The effects of the following system parameters and properties on the overall distortion and rate-ratio are analyzed. A rationale for comparing and choosing among three systems—uncompressed–uncoded, compressed–uncoded, and compressed–coded—is given in terms of the performance measures. Author

N67-27630# Japan Broadcasting Corp., Tokyo. Radio Frequency Research Div.
TRANSMITTING ANTENNAS USING SUPPORT MAST DIFFRACTION
Yukio Endo and Hiroshi Okamura Jan. 1967 38 p refs

Various transmitting antenna systems for use in VHF, TV, and FM radio broadcasting were studied in an effort to use their mast diffraction phenomena positively. Theories for these systems were developed and experimental results were obtained for: (1) a non-directional antenna for horizontal polarization, and (2) a non-directional antenna and a directional antenna for vertical polarization, with tubular mast and dipole assembly. It was found that the support mast of a TV supergain antenna can be used as FM transmitting unipole antenna; various directivities were obtained by varying the diameter of the support mast and the distance between mast and dipole assembly. G.G.

N67-27635*# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrical Engineering.
A SPACE COMMUNICATION STUDY Progress Report, 15 Sep. 1966–15 Mar. 1967
Kenneth K. Clarke, Raymond L. Pickholtz, and Donald L. Schilling Mar. 1967 46 p refs
(Grant NGR-33-008-020)
(NASA-CR-84452) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Work in space communications centered on the following topics: (1) *Optimal Reception of FM Signals Using the Maximum Likelihood Estimator*—iteration technique to obtain solution for MLE equation; (2) *Threshold Extension Devices*—digital computer solution to phase locked loop by spike approach and solution of Fokker Planck equation, frequency locked loop FM demodulator, and multiple threshold spike detection and elimination systems; (3) *Detection of Signals in Noise Using Recursive Techniques*—state variable

solution for detection of known signals in non-white Gaussian noise; (4) *Channel Simulation Experiments*—basic configuration of modified channel simulator having a rotating pattern of reflectors instead of the air bubble cloud; and (5) *Synchronization Techniques*—binary phase-shift keyed communications systems. G.G.

N67-27660*# Space-General Corp., El Monte, Calif.
EVALUATION OF THE BREADBOARD MICROWAVE METEOROLOGICAL RADIOMETER AND SCANNING ANTENNA
J. J. Kirwan, P. R. Jordan, and R. Greenwood 15 Mar. 1967 75 p refs
(Contract NAS5-9680)
(NASA-CR-84485; SGC-939R-7) CSCL 09F

Results of measurements which were performed on the Nimbus breadboard electronic scanning antenna array are summarized. This series of measurements was intended primarily to establish the radiometric beam efficiency and to measure the dissipative loss of the Nimbus array over its range of scan angles, ±50°. Also, the measured radiometric temperature of an object filling the main beam of the antenna was quantitatively related. The measurements were performed at Table Mountain, California, at an altitude of 7200 feet, thus minimizing the atmospheric absorption contributions to the zenith sky temperatures. Details of the theory behind the measurements and of how the measurements were actually performed are discussed, along with significant results and conclusions. Appendices describe the calibration of the radiometer, the cryogenic bench test site, the zenith sky temperature, and the sun drift curves. C.T.C.

N67-27724# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ANALYTICAL SIGNAL PROCESSING TECHNIQUES IN A REVERBERATION-LIMITED ENVIRONMENT
W. Abramowitz Jun. 1966 55 p refs
(RE-262) CFSTI: HC $3.00/MF $0.65

Four approaches to signal detection in a clutter (reverberation) environment are presented. They are: Urkowitz's use of a mean-square criterion (maximization of the signal-to-noise ratio) to obtain an optimum linear filter; Rihaczek's addition of fluctuation noise as an extension to Urkowitz's procedure; Westerfield, Prager, and Stewart's application of the Woodward ambiguity function to study the echo-to-reverberation ratio at a matched filter output; and Van Trees' use of a statistical model of the reverberation and hypothesis testing to obtain an expression for an optimum receiver. Recommendations are proposed for both a relatively short term and a long term signal processing program. For the former, this will include reverberation modeling and investigation of matched filter synthesis, signal design, and the ambiguity function. For the latter, included will be simplification, if possible, of the results of applying statistical hypothesis testing to the reverberation problem, and the use of updated reverberation data in a signal processing system. Author

N67-27725# Illinois State Water Survey, Urbana.
RADAR ANALYSIS OF PROJECT WARM RAIN, HILO, HAWAII—SUMMER, 1965 Final Scientific Report
R. G. Semonin, E. A. Mueller, G. E. Stout, and D. W. Staggs 17 Feb. 1967 22 p refs
(Grant NSF GP-194)

Two X-band radar sets, an M-33 and a GPG-1, were operated routinely on the island of Hawaii to obtain data on the warm rain mechanism. The M-33 was located at the University of Hawaii. The data obtained from the PPI scope photography were used to determine preliminary climatological parameters associated with trade wind showers. The relationship between echo frequency and rainfall was remarkably good. These results show that the rainfall rate during the data collection period was very uniform. There was a greater frequency of echoes per unit area over land than over water due to the breakup of organized lines or bands of showers as they moved inland. There is also a distinct decrease of echo frequency with increasing range, but this cannot be accounted for by range attenuation or atmospheric refraction. The relationship between echo movement and the trade winds was studied. The results indicate that the radar echoes tend to move to the right of the wind direction with a greater speed than the environmental wind. The GPG-1 radar was located on the windward slope of Mauna Kea, but little useful data were obtained due to trapping gradients associated with the trade inversion. Author

N67-27740# Joint Publications Research Service, Washington, D. C.
SOVIET RESEARCH ON SELECTION OF OPTIMAL WORKING COMMUNICATION FREQUENCIES
Yu. G. Mizun 21 Feb. 1967 13 p refs Transl. into ENGLISH from the book "Vysokoshirotnyye Issled. Y Oblasti Geomagnetizma I Aeronomii" Leningrad, Izd. Nauka., 1966 p 102–111
(JPRS-39977; TT-67-30624) CFSTI: HC $3.00/MF $0.65

A probability study was made on the distribution of the critical frequencies of the F2 layer. Conclusions are drawn concerning the expediency of forecasting for high latitudes along with MPChF2 the probability of achieving radio communications by radio wave reflection from the F2 layer on MPChF2. The probability is defined by the function $R = P(1 - F)$, where P is the probability of radio wave reflection from the F2 layer, F is the distribution function of the random sequence of variables f_0F2, and R is the communications guarantee function by means of the F2 layer. The communications guarantee function gives the probability of communication by means of the F2 layer on a given frequency. Author

N67-27759# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab
VOR/LOCALIZER FLIGHT INSPECTION RECEIVER Final Report
E. M. Drogin, J. A. Lovell, and J. M. Tegins Jan. 1967 66 p
(Contract FA-65-WA-1271)
(SRDS-RD-67-4)

Two feasibility models of a receiver were developed for the reception of VOR signals and the localizer portion of ILS signals. The receiver is designed as a highly accurate instrumentation-quality unit for specialized flight inspection application. To obtain the accuracy required for the flight inspection of VOR signals, a number of departures from existing commercial designs were required, e.g., an IF amplifier with low cross-modulation and flat response beyond the subcarrier sidebands, a highly linear IF detector, AGC circuits with smoothly changing logarithmic AGC voltage and stiffer control on the detector output level, filters for the 30-cps signals with matched phase-response, digital circuits for accurate phase comparison of the two 30-cps signals, and linear amplitude filters and rectifiers for separating and detecting pertinent audio components. Design changes made to obtain high accuracy for the flight inspection of localizer signals include more careful design of the 90- and 150-cps filters to assure stability in modulation difference and sum and use of a novel rectifier circuit giving greater linearity. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N67-26499# Naval Weapons Lab., Dahlgren, Va.
SUBROUTINES FOR IBM SYSTEM/360 TO FACILITATE VISUAL DISPLAY AND MAN MACHINE RELATIONSHIPS
David F. Eliezer 23 Aug. 1966 240 p refs
(NWL-2074; AD-646895) CFSTI: HC $3.00/MF $0.65

A group of subroutines is described which facilitates the utilization of the buffered IBM 2250 display terminal associated with an IBM System/360. The routines provide a means of displaying graphs and textual material and provide for efficient use of the light pen and other associated devices. Author (TAB)

N67-26500# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MAGNETIC FILM MEMORY EVAPORATION SYSTEM
Charles G. Ryan 6 Jan. 1967 23 p refs
(Contract AF 19(628)-5167)
(TN-1967-4; ESD-TR-67-17; AD-647209) CFSTI: HC $3.00/MF $0.65

The system facilitates the deposition of large area magnetic film memories and the observation of wall coercive force during an annealing cycle. It provides for sixteen substrates 1.6 inches wide by up to thirty inches in length to be sequentially coated. Three induction heated sources are employed containing up to one pound of melt in each crucible plus additional resistance heated sources for the evaporation of a chromium underlayer with enhances adhesion of the magnetic film to the substrates. Author (TAB)

N67-26519*# Borg-Warner Controls Div., Borg-Warner Corp., Santa Ana, Calif.
SERVO CONTROL AND DATA SYNCHRONIZATION STUDY
Benton Bejach 21 Feb. 1967 31 p refs Prepared for JPL
(Contract NAS7-100; JPL-951659)
(NASA-CR-84145; Rept.-70-007-Q1) CFSTI: HC $3.00/MF $0.65
CSCL 09B

An investigation was made of the feasibility of a magnetic tape recorder–reproducer capable of (1) accepting data pulses at varying rates, (2) making maximum usage of storage space by recording data at a constant rate, and (3) retrieving the recorded data at a rate synchronized to an external clock. This report gives a theoretical description of such a recorder. Tape speed changes are controlled by a closed-loop electromechanical servo system. Error signal for the servo is derived from the incoming data rate and the amount of data in buffer storage. Speed is adjusted so that incoming data never overflows buffer storage capacity and gaps are not recorded on the tape. For data retrieval, the process is somewhat reversed. Data are read from the tape into buffer storage. Data output from buffer storage is synchronized to a master clock. Tape speed is derived from data output rate requirements and the amount of data in buffer storage. Author

N67-26586*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DOCUMENTATION FEATURES FOR COMPUTER PROGRAMS
Abrom Hisler Apr. 1967 39 p refs
(NASA-TM-X-55771; X-565-67-170) CFSTI: HC $3.00/MF $0.65
CSCL 09B

Methods of documenting computer programs are discussed and their application to various facets of planning, development, and operation is demonstrated. To illustrate, examples are given which were taken from a preliminary report on the PUTT (propellant utilization time trace) program to simulate the vertical ascent of a boost-sustain sounding rocket. These include: (1) briefs for programs and subprogram documentation, covering program language, running time, computer to be used, lines of output, and key concepts and areas of information retrieval; (2) program listing with running commentary and references to the literature; (3) engineering analysis which outlines the basic nature of the computations and shows the necessary input information, together with the calculation flow to provide the desired output; (4) the decoding sheet indicating which parameter must be inputted initially, which is putputted as a result of computations, and which remains in the program; (5) the correlating input format to feed the necessary data for a test run; and (6) the input and output data display sheets. M.G.J.

N67-26587*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ADVANCED SPACE INFORMATION SYSTEMS
George H. Ludwig Apr. 1967 20 p refs
(NASA-TM-X-55774; X-560-67-209) CFSTI: HC $3.00/MF $0.65
CSCL 09B

At the present time we are processing data from 16 scientific orbiting spacecraft at a rate of 160 tapes per day or about 150 million measurements per day. The present on-board data handling systems are now quite complex and capable. The data are being processed on the ground with second generation equipment, and third generation equipment is coming into use in some cases. Increasing amounts of real time data relay from the ground stations are being used for operations reasons. The evolutionary process toward higher data volumes and higher raw information rates from the basic sensors is continuing, as the experiments are designed to conduct more and more detailed measurements. This is necessitating a careful look at the next generation data systems which are expected to include general purpose on-board computers for pre-transmission data processing, automation of data acquisition stations, more extensive real time data relay to the control centers, and more easily usable ground facilities for providing dynamic display of the space measurements to the experimenters for more rapid analysis. Author

N67-26613# Illinois Univ., Urbana. Coll. of Engineering.
COMPUTER SCIENCE
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 199–203 refs
(See N67-26601 14-34)

Digital computer research at the University of Illinois is highlighted. ILLIAC II, a large-scale, high-speed computer and an IBM 7094-1401 system is featured. Technical details are also given for the Pattern Recognition Computer (ILLIAC III), and a parallel network computer (ILLIAC IV). R.U.

N67-26657# Ballistic Research Labs., Aberdeen Proving Ground, Md.
DATA REDUCTION FROM PHOTOGRAPHS OF BLASTS
Aivars K. R. Celmins Nov. 1966 143 p refs
(BRL-MR-1804; AD-648947) CFSTI: HC $3.00/MF $0.65

The report gives a detailed description of a code for reduction of data from blast photographs. The code furnishes data about the orientation of the camera, computes scale factors of the frames, expresses the refractive distortion of the Suns image in proper angles and determines the parameters of a function R sub o(f), which gives the radius of the blast bubble as a function of the frame number f (i.e., time). The distortion data are corrected by the code for a constant movement of the camera and can be used for the calculation of the air density within the blast bubble by other codes already in use. Author (TAB)

N67-26680# Stanford Research Inst., Menlo Park, Calif.
USER'S MANUAL FOR THE CALM LEARNING-MACHINE SIMULATION PROGRAM Final Documentary Report, Apr.–Nov. 1966
John H. Munson Griffiss AFB, N. Y., RADC, Feb. 1967 96 p
(Contract AF 30(602)-4216)
(RADC-TR-66-781; AD-648959) CFSTI: HC $3.00/MF $0.65

The CALM (Collected Algorithms for Learning Machines) program system is a means of implementing a wide class of learning machines on a digital computer. A learning machine is a

trainable pattern classifier, built around an array of adaptive logic elements, that categorizes patterns on the basis of its past experience. The CALM system provides a framework for learning-machine simulation largely independent of the computer used and the types of patterns being classified. The actions performed by CALM include training a learning machine on a set of patterns, testing the classification error rate of the trained machine on the same or an independent set of patterns, and modifying, saving, and restoring the machines memory and control parameters. The report is a users manual for CALM, and specifically for the CALM system implementation for the General Electric 635 computer. The report covers the nature of the learning machines realized by CALM, the CALM program itself, and the use of CALM in learning-machine experimentation. Author (TAB)

N67-26663# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN RESULTS OF RESEARCH ON SELF-OPTIMIZING ANALOG COMPUTERS

Dao-yuen Hu, Ma-ming Shen, and Lung Tong 5 Dec. 1966 23 p refs Transl. into ENGLISH from Ching Hua Ta Hsueh Hsueh Pao (Peking), v. 12, no. 2, 1965 p 23–36

(FTD-HT-66-573; AD-648886) CFSTI: HC $3.00/MF $0.65

The performance of an analog computer can be increased and its field of application broadened by extending the logical capabilities and increasing the accuracy and speed of problem solving on it. The design of the Tsing-hua 566 is an effort in this direction. This paper gives an account of the results of this work. TAB

N67-26781# RAND Corp., Santa Monica, Calif.

SOVIET CYBERNETICS: RECENT NEWS ITEMS, NO. 1

Wade B. Holland, ed. Feb. 1967 76 p refs

(P-3600/1; TT-67-61276; AD-648594) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE BESM-6 COMPUTER W. B. Holland p 7–18 refs (See N67-26782 14-08)

2. THE M-20 COMPUTER: TECHNICAL SPECIFICATIONS AND PREVENTIVE MAINTENANCE PROGRAM p 19–21

3. MINSK-22 IN MOSCOW EXCHANGES DATA WITH OGE 4115 IN MILAN p 22

4. APPLICATION OF URAL-11, -14, AND -16 p 23–24

5. THE APPLICATION OF DIGITAL LOGIC ELEMENTS OF THE 'URAL-10' COMPLEX TO ANALOG DEVICES FOR SOLVING BOUNDARY-VALUE PROBLEMS p 25–32 refs

6. THE UM1-NKhP p 33–35

7. CONNECTING A DIGITAL COMPUTER TO TELEGRAPH COMMUNICATION LINES IN A COMPUTER CENTER p 36–40

8. THIRD GENERATION p 41–42

9. PERSPECTIVES IN THE USE OF COMPUTER TECHNOLOGY p 43–44

10. THE FRUITS OF SCIENCE TO PRODUCTION p 45–47

11. INSTITUTE OF SOCIAL RESEARCH p 48–50

12. THE INTRODUCTION OF COMPUTER HARDWARE AND AUTOMATED CONTROL SYSTEMS INTO THE NATIONAL ECONOMY p 51–59 ref

13. RATIONALIZATION OF MANAGEMENT LABOR IN CZECHOSLOVAKIA p 60–61

14. ARTICLES AND PHOTOGRAPHS IN THE SOVIET PRESS p 62–68 refs

15. BIBLIOGRAPHY OF RAND CORPORATION PUBLICATIONS IN SOVIET CYBERNETICS AND COMPUTER TECHNOLOGY p 69–74

N67-26782# RAND Corp., Santa Monica, Calif.

THE BESM-6 COMPUTER

Wade B. Holland *In its* Soviet Cybernetics: Recent News Items, No. 1 Feb. 1967 p 7–18 refs (See N67-26781 14-08)

Presented are general information and technical specifications for the Soviet Union's newest and fastest computer, the BESM-6. The BESM-6 is intended to supersede the BESM-2 and the M-20 computers in scientific and engineering applications requiring very high speeds and large scale production. The machine has the largest and fastest known store in a Soviet machine, and it may be overlapped. There appears to be instruction look-ahead capability and I/O is buffered. The design seems to emphasize minimal core usage, understandable in view of a rather limited core store of only 32,000 words. Extensive use is made of a system whereby data storage referencing is overlapped with arithmetic operations and with control functions; there are probably five levels of instruction look-ahead. Provision is made internally for the use of any part of the memory as a stack or push-down store. The central processor has 16 high speed general purpose registers operating at 200 nanoseconds. Unlike previous Soviet computers, the BESM-6 design reflects the demands of automatic programming and translation from algorithmic input languages. The installation of a prototype model at the Computer Center of the USSR Academy of Sciences in Moscow, is cited. Cost estimates for the BESM-6 range from 1.21 to 3.3 million dollars. Technical data on the instruction system; times of basic operations; index register length; core cycle time; core read access time; clock frequency; number of interrupt lines; I/O system; external storage system; permissible ambient air temperature; permissible relative humidity; air conditioning; power; and size; are included. S.C.W.

N67-26806# Imperial Coll. of Science and Technology, London (England). Electrical Engineering Dept.

RELIABLE COMPUTATION WITH UNRELIABLE ELEMENTS

J. D. Cowan Jul. 1966 17 p refs

(Contract N62558-4256)

(AD-646625) CFSTI: HC $3.00/MF $0.65

The paper discusses computer system designs for operation at any required level of reliability, given unreliable elements. Methods discussed are: control of stationary errors and fault-masking of transient errors. TAB

N67-26827# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.

TABULAR LINE-OF-BALANCE PRODUCTION CONTROL TECHNIQUE

D. J. Bostock 11 Aug. 1966 25 p ref

(Contract W-7405-ENG-26)

(Y-KA-17) CFSTI: HC $3.00/MF $0.65

The operation of a tabular line-of-balance production control system used in production scheduling and control of weapon components is described. The advantages of the tabular line-of-balance system are obvious. First, it allows "management by exception". Only those areas where a minus status appears require attention. Second, the four report formats used are simple and explicit. Interpretation of the data is easy once an understanding of the basic system is obtained. Third, the reporting formats are reasonably flexible. For example, a sorting of data by operating areas rather than by program can be accomplished with little effort. The disadvantages of the system are: a high degree of accuracy is required of the basic input data; transmissions must be made and made accurately if the reports are to be used by front-line supervision for day-to-day operating decisions; part routing and the sequence of operations must adhere to the pattern prescribed by the lead-day network or the in-process inventory calculations will be meaningless; the total system, from scheduling to reporting of status, is reasonably flexible but frequent changes will increase the cost of the operation excessively; and the system requires detailed planning and preparation; thus, the system is time consuming and expensive. Its use is justified when attempting to control complex programs with many operations, parts, and diverse responsibilities. However, the tabular line-of-balance system is an invaluable management tool. Author (NSA)

N67-26832# Battelle-Northwest, Richland, Wash.
CONTROL PROGRAM DEVELOPMENT Interim Report
J. R. Kosorok Dec. 1966 72 p refs
(Contract AT(45-1)-1830)
(BNWL-348) CFSTI: HC$3.00/MF$0.65

Hardware and software requirements of a successfully implemented direct digital control program for multiloop control are defined. Test results of the program with a simulated process show that sampling intervals of one-twelfth to one-fifth the effective process time constant give stable control for a process having an effective dead time approximately equal to the process time constant. Author (NSA)

N67-26838# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
DMIN1 AND DMIN2: TWO SUBROUTINES FOR THE UNCONSTRAINED MINIMIZATION OF A FUNCTION OF SEVERAL VARIABLES
G. W. Stewart, III 19 Jan. 1967 18 p refs
(Contract W-7405-ENG-36)
(K-1685) CFSTI: HC$3.00/MF$0.65

This report contains descriptions and listings of the FORTRAN IV subroutines DMIN1 and DMIN2 for the unconstrained minimization of a function of several variables. The programs are based on a method of Davidon. Author (NSA)

N67-26841# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSACTIONS OF THE ALL UNION CONFERENCE-SEMINAR ON THE THEORY AND METHODS OF USING MATHEMATICAL MODELS
13 Jan. 1967 517 p Transl. into ENGLISH of the book "Kombinirovannyye Vychislitel'nyye Mashiny" Moscow, Izd. Akad. Nauk SSSR, 1962 p 1–295 Conf. held in Moscow, 1–4 Nov. 1961
(FTD-MT-64-344; TT-67-60878; AD-646712) CFSTI: $3.00

Conference papers on hybrid computers, digital differential analyzers and digital simulators, converters for representations of magnitude, repetitive analog computers, and special questions in analog computer technology are presented. For individual titles see N67-26842–N67-26868.

N67-26842 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON PRINCIPLES OF CONSTRUCTING HYBRID COMPUTERS
B. Ya. Kogan *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 9–32 refs (See N67-26841 14-08)

The characteristic advantages and disadvantages inherent in analog and digital computers are analyzed in relation to the need of constructing hybrid systems. Two basic trends in creating such combined systems are discussed: (1) combining individual computing elements with different representation of magnitudes within one computer; and (2) combining computers with different representation of magnitudes within the framework of a single investigated problem. The use of hybrid computers for investigating complex systems of automation is also considered, and the three basic variants of the structures which may take place are assessed. These are analog computer in combination with a digital, analog computer in combination with a digital simulator or a digital differential analyzer, and numerical model in combination with a digital computer. M.G.J.

N67-26844# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HYBRID COMPUTER FOR STATISTICAL DATA PROCESSING
A. F. Romanenko and G. A. Sergeyev *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 47–55 (See N67-26841 14-08)

The theory and method of interpreting random processes in the output of automatic control systems (ACS) are described. Interest is centered on the problem of correlating output errors in the ACS with the disturbance of stationary and ergodicity conditions taken into account. The nonstationary condition associated with the finite time of selection is evaluated by preliminary smoothing to isolate the stationary components of the high frequency structure of the process. A hybrid computer for statistical data processing is described, and a block diagram is shown. It is concluded that the hybrid system effectively solves the problem of the statistical treatment of processes with disturbed stationary conditions. M.G.J.

N67-26845# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINCIPLES OF DESIGN AND APPLICATION OF COMPUTERS OPERATING ON INCREMENTS
F. V. Mayorov *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 59–76 refs (See N67-26841 14-08)

Real-time digital computers and their areas of application are discussed, and their major deficiencies, particularly when applied to automatic control systems, are noted. The development of digital differential analyzers, and of digital computers operating on the principle of increments is also discussed. Three types are considered: series and parallel digital differential analyzers, and digital integrating machines with a variable step. Details are given on the peculiarities of each, their characteristics, and their particular fields of application. M.G.J.

N67-26846# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE DESIGN STRUCTURES OF SPECIALIZED DIGITAL COMPUTERS
G. M. Kozyreva and A. V. Shileyko *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 77–99 refs (See N67-26841 14-08)

Computer design synthesis is examined, and the problem is formulated by finding the total number of design indices to satisfy the system of inequalities comprising the technical specifications. The synthesis of a digital computer for solving systems of ordinary first order differential equations is described. A detailed example is given to illustrate the use of the proposed method. M.G.J.

N67-26847# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN QUESTIONS IN CONSTRUCTING SERIAL DIGITAL DIFFERENTIAL ANALYZERS
K. S. Neslukhovskiy *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 101–118 (See N67-26841 14-08)

Design details are presented on a control unit for programming problems in a series-type digital differential analyzer. Commutation of the plugboard hubs is accomplished by flexible cords corresponding to conventional integrators. The plugboard for 60 integrators is described and shown schematically. Also described is an integration block (arithmetic unit) of a serial digital differential analyzer with a variable system of notation. This is designed so that a change in the number system does not affect the remaining units of the computer. The integration is adjustable to either the binary or binary–decimal systems. Several examples are given to illustrate its operation. M.G.J.

N67-26848# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SERIAL DIGITAL DIFFERENTIAL ANALYZERS WITH A MNEMONIC CIRCUIT FOR PROBLEM SETUPS

A. A. Gurakov and A. G. Shevelev *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 119–134 refs (See N67-26841 14-08)

The use of a memory unit in a digital differential analyzer is discussed, and methods of control operations by means of a plugboard are assessed. These operations are classified according to those which must be executed simultaneously in all the integrators, and those which must be performed in individual integrators. Techniques for interconnecting the integrators are examined. Consideration is given to magnetic core storage with recording and access units; commutation of storage cells; ternary system of encoding the increments; and integrator interconnection with a shift register. M.G.J.

N67-26849# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON METHODS OF INCREASING THE HIGH SPEED OPERATION AND EXPANDING THE LOGICAL POSSIBILITIES OF DIGITAL DIFFERENTIAL ANALYZERS (DDA)

A. V. Kalyayev *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 135–150 (See N67-26841 14-08)

Two methods for increasing the speed of digital differential analyzers (DDA) are assessed: one involves high speed operation of individual elements which is dependent on the development of pulse technology; the other involves developing corresponding structures. Four groups are considered: series–serial, series–parallel, parallel–serial, and parallel–parallel. Different construction principles are examined, and it is concluded that the series–parallel type requires a significantly smaller amount of equipment than the other types. To expand the logic possibilities, emphasis is placed on the need to assure the high speed electronic commutation of DDA, and the possibility of changing the program in the operation process based on a logical analysis of external and internal information. M.G.J.

N67-26850# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DIGITAL INTEGRATOR WITH TERNARY SYSTEM FOR ENCODING INCREMENTS

A. A. Gurakov and A. G. Shevelev *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 153–175 refs (See N67-26841 14-08)

The operating principle and the circuit performance of the digital integrator with a ternary system for encoding the increments are described. The chief distinction of such a system is cited as its specific method of realizing the integration operation in the integrators. In the case considered, the integrator is arbitrarily separated from the overall circuit as its operation is examined in a definite interval of time (digital differential analyzer with serial operation). M.G.J.

N67-26851# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTEGRATION BLOCK OF A DIGITAL INTEGRATING MACHINE

B. V. Barun, E. M. Zelinskiy, and V. I. Sergiyenko *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 176–187 ref (See N67-26841 14-08)
(MT-64-218)

A digital differential analyzer (DDA), which operates in a binary system with a fixed point, is described. A logic circuit for integral increment formation in the integration block of a digital integrator is also described and depicted. Basic devices essential to the integrating block are assessed. These include increment storage, increment counters, and one-column serial adders. Block diagrams of each are included. M.G.J.

N67-26852# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEMORY UNIT OF A DIGITAL INTEGRATOR

R. I. Meleshkevich and G. I. Petrov *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 189–209 ref (See N67-26841 14-08)

Details are given on the memory unit which consists of two blocks operating simultaneously and storing information for the Y and S registers of the digital control machine. The interaction of the fundamental parts of the unit is described. The memory unit stores 64 36-column numbers. One half of each column comprises the contents of the Y and S registers; both halves of each number enter the unit and are conducted from it through different channels. Operational principles are also described, and schematics on the various elements are included. M.G.J.

N67-26853# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN QUESTIONS ON THE THEORY OF THE ACCURACY OF CONVERTERS

B. G. Dostupov *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 213–222 refs (See N67-26841 14-08)

The question of selecting a rational register length is examined in relation to the accuracy of analog-to-digital and digital-to-analog converters. It is assumed that a certain analog magnitude, measurable with an error, will be converted to the digital equivalent. The two errors which will appear in such a conversion are discussed, and equations are formulated to determine the mathematical expectancy and the dispersion of the converters' errors. A determination is also made of rational register length values in reference to certain types of converters. Two basic cases are considered: (1) The magnitude being converted is constant and is not equal to zero. (2) The magnitude being converted varies from zero at a variable rate. M.G.J.

N67-26854# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON COMPUTING CONVERTER ERRORS OF VOLTAGE INTO CODE AND OF CODE INTO VOLTAGE

K. P. Zhukauskas *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 223–229 (See N67-26841 14-08)

The errors made by a converter that operates on the principle of comparing input voltage with a voltage whose values are proportional to the corresponding binary numbers are considered. In the intervals between the conversion cycles, the output voltages are stored in the condensors. Author

N67-26855# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON DESIGNING RESISTANCE LADDER NETWORKS FOR A "CODE VOLTAGE" CONVERTER

K. A. Netrebenko *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 231–235 ref (See N67-26841 14-08)

Multidischarge voltage dividers used to convert binary codes into voltage are described. Depending upon the output voltage, the circuits may be used for converting any weighted code if the relative magnitudes of the resistances are selected appropriately.

and may be freed of structural error if the single pole switches are replaced by two-directional ones. Equations are also derived for calculating the resistance values of a ladder-type network. M.G.J.

N67-26856# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TRANSISTOR DIGITAL–ANALOG CONVERTER

T. M. Aleksandridi and Ye. A. Fateyev *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 237–252 ref (See N67-26841 14-08)

Details are given on a transistorized digital–analog converter intended for operation at industrial automation facilities, and used to connect a digital computer to an actuator. In addition, the converter is required to store the converted values for a one-cycle period. Author

N67-26857# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TRANSISTORIZED MULTICHANNEL CONVERTER OF VOLTAGE INTO DIGITAL CODE AND OF DIGITAL CODE TO VOLTAGE

R. Kh. Babich and V. V. Lunin *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 253–270 (See N67-26841 14-08)

A multichannel converter was developed in order to effect a coupling between the digital integrator and the controlled object whose transducer readings are fed into the control machine. Data input magnitudes are fed in as increments obtained after an interval of time between given and preceding iterations. The operating principle and the voltage to code converter are discussed, and the cirteria for selecting the electronic voltage divider circuits are defined. Methods of compensating for the errors introduced by switches into converter operation are assessed. Details are also presented on the transducer commutator switch, the voltage comparison circuit, and the converter control circuit. M.G.J.

N67-26858# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GENERAL PURPOSE ANALOG-TO-DIGITAL CONVERTERS

V. A. Avtonomov *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 271–290 (See N67-26841 14-08)

The advantages of time–pulse analog-to-digital converters are reviewed, and possible variations in their functional diagrams are discussed. Technical specifications are given for an experimental model designed to convert direct current voltage to the number of pulses proportional to it. The number of active elements for the one-bit column is equal to two; with the three-bit binary decimal counter taken into account, the number is equal to five. Test results are tabulated. M.G.J.

N67-26859# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A VOLTAGE TO CODE AND CODE TO VOLTAGE ELECTRONIC CONVERTER FOR BESM-2 HIGH-SPEED COMPUTERS

K. P. Zhukauskas and I. Yu. Petkyavichus *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 291–308 refs (See N67-26841 14-08)

Design details are given on the converter which is assembled from standard blocks of the computer and of the voltage-sensitive gate cells. A separate stable pulse generator synchronizes its operation; the maximum frequency of the generator pulse sequences is limited by the high speed operation of the magnetic operational memory unit circuit. Developed to effect the parallel conversion of four functions whose information is stored in tabular form in the memory unit, the converter is also intended for the inverse transformation of four continuous functions of time. The purpose of the individual converter blocks is explained; these include control pulses and potentials, control counter, seven-column counter, reversible counter, and the input–output block. Procedures for converting voltage-to-code and code-to-voltage are described. M.G.J.

N67-26861# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON CERTAIN QUESTIONS OF USING ANALOG COMPUTERS IN OPTIMUM CONTROL SYSTEMS

F. B. Gul'ko *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 335–344 refs (See N67-26841 14-08)

The use in optimum automatic control systems of repetitive analog computer components (ACC) operating on an accelerated time scale is discussed. The requirements for high speed ACC are defined, and two methods of solving the problem of optimum prediction are described. Two examples are given to show how the ACC compute the family of trajectories of specific structure passing through different points in a space of states of the system. The corresponding equipment selects such a trajectory which will pass through a given point. M.G.J.

N67-26862# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON USING AN AVERAGED ESTIMATE IN SEARCHING A MINIMIZATION METHOD IN THE MN-11 ANALOG COMPUTER

I. M. Vitenberg and Ye. A. Yerokhin *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 345–365 refs (See N66-26841 14-08)

The averaged estimate of the probability of a false signal is used in searching for a minimization method used in an analog computer. The character of the change in variables with a constant incremental magnitude is analyzed, and the expediency of using the averaged estimate of the magnitude is shown. It is pointed out that one of the most important qualities of the MN-11 computer, based on its high speed operation and automation of searching for useful solutions, is the possibility of solving unstable problems with large changes at the end of the solution interval and with small changes of the modified parameters. M.G.J.

N67-26863# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN PROBLEMS IN CONSTRUCTING SPECIALIZED ANALOG COMPUTERS (WITH THE USE OF REPETITIVE OPERATION AND CONSOLIDATION OF EQUIPMENT IN TIME)

I. M. Vitenberg *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 369–402 refs (See N66-26841 14-08)

The selection of amplifiers for special purpose analog computers is discussed in relation to the requirements posed by the specific class of problems to be solved. The additional errors made by analog computers operating in a solution iteration mode are examined, and a method of evaluating the errors due to the lower sensitivity of operational amplifiers is presented. Consideration is also given to the multiple use of the computing elements with attention focused on selecting the frequency of input voltage connections to a repeatedly used system contained in the circuit for forming a derivative, and on the expediency of using repeatedly utilized systems from the viewpoint of reducing the amount of equipment. M.G.J.

N67-26864# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PECULIARITIES IN CONSTRUCTING OPERATIONAL AMPLIFIERS IN HIGH-SPEED ANALOG COMPUTERS

D. Ya. Polonnikov *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 403–413 refs (See N67-26841 14-08)

The requirements imposed on a computing amplifier of high speed analog computers are delineated, and the basic errors inherent in many of the assumptions are pointed out. An ideal integrator design is described, and an error analysis of the system is presented. The results indicate that the error component introduced by the amplifier should be a few times smaller than the error owing to imperfections in elements of the feedback circuit. Based on a literature survey, three methods of constructing operational amplifiers are outlined. These include precision amplifiers with a modular–demodulator, direct current amplifiers without a modulator–demulator, and alternating current amplifiers. M.G.J.

N67-26866# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PRINCIPLES IN CONSTRUCTING MULTICHANNEL MULTIPLIERS

A. A. Maslov *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 31 Jan. 1967 p 427–439 refs (See N67-26841 14-08)

Comparative evaluations are presented on systems with parallel computer channels as applied to multipliers. These include high precision multipliers with a controllable transmission factor and a digital servo system; coarse–fine multiplier; transition to a frequency separation of channels with a nonlinear transfer function; and a three-channel multiplier containing two digital servo systems and a high frequency multiplier. Technical indices of the considered versions are tabulated, with the multiplier's transmission band equal to 10 cps. M.G.J.

N67-26867 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FUNCTION GENERATOR OF GRAPHICAL DATA

A. I. Petrenko *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 441–456 refs (See N67-26841 14-08)

The problem of direct automatic input of textual and graphic data into a computer is considered, and a graphic data function generator designed for this purpose is described. The proposed generator is based on the principle of a pulse servosystem which makes it possible to realize simultaneously the advantages of servo and scanning transformation methods. A reflected light beam technique is incorporated so that graphs and recordings can be used as input functions independently of carrier type and its dimensions. A schematic of the instrument is included, along with a diagram showing the operational principles. A specially designed unit converts the primary light pulses into secondary electrical pulses assuring a reliable reading during variations in the amplitude of input pulses. M.G.J.

N67-26868 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE USE OF DIGITAL METHODS IN SYSTEMS OF CONTROL DATA INPUT AND OUTPUT OF ANALOG COMPUTERS (AC)

G. M. Petrov *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 457–474 (See N67-26841 14-08)

Consideration is given to the construction principles of analog computer components which assure the input and output of data in digital form. These include the control system, commutator, analog to digital converters, and input device for constant coefficients and nonlinear relationships. A functional diagram of the data input–output unit is included. These consist of two parts: one for reading the data from punched tape and forming the instruction for transmitting to the analog computer; the other for receiving data from the analog computer and printing them on paper in a convenient form for analysis. The three most characteristic modes of joint operation of the input—output unit and the hybrid computer are classified as (1) setup of the transmission coefficients of potentiometers from punched tape; (2) static control of the computing blocks; and (3) step-by-step solution. An experimental check of the digital data input and output system showed satisfactory results for all fundamental modes. M.G.J.

N67-26887 Frankford Arsenal, Philadelphia, Pa.

A DIGITAL COMPUTER SIMULATION OF BREECH-LAUNCHED ROCKETS

Leonard A. de Stefano Jan. 1967 35 p refs
(M67-18-1; AD-648152) CFSTI: HC$3.00/MF$0.65

The report documents a digital computer simulation of solid propellant breech-launched rockets. The equations describing the system are presented and solved by Runge-Kutta methods programmed in Fortran for the Univac Solid State 90 digital computer. The computer program, its input and output formats, and comparison with experimental performance are also presented. It is also shown how the program can be used to simulate certain other ballistic devices. Author (TAB)

N67-26910# Illinois Univ., Urbana. Dept. of Electrical Engineering.

SERIAL DECOMPOSITION OF SEQUENTIAL MACHINE INTO SPECIFIED CLASSES OF SUBMACHINES

Earl David Crockett (Ph.D. Thesis) Feb. 1967 71 p refs
(Contract DA-28-043-AMC-00073(E); Grant NSF GK-36)
(R-338; AD-648557) CFSTI: HC$3.00/MF$0.65

A sequential machine decomposition into a specified class of submachines is given. The decomposition is serial, allowing only feedback lines within the submachines. Graph-theoretical techniques are developed to perform operations on the transition graphs which indicate the type of submachines and the interconnecting logic. These are translated into operations on the matrices which represent the transition graphs, and an iterative decomposition procedure is given. The techniques developed can also be used to find the largest block partitions with the substitution property. The theory holds for either completely or incompletely specified sequential machines and is extended to apply to ones in which a decomposition is possible only after state splitting. Author (TAB)

N67-26918# Grafix, Inc., Albuquerque, N. Mex.

COMPUTER PROCEDURES AND PROGRAMS FOR THE AUTOMATION OF CONATIVE PROCESSES Final Report

Gene R. Bussey 31 Dec. 1966 136 p refs
(Contract AF 49(638)-1476)
(AFOSR-67-0703; AD-648267) CFSTI: HC$3.00/MF$0.65

PUPIL II, a general adaptive motor learning program for an IBM 360/40F computer, is described and listed. The program is written in BPS Fortran IV and is a successor to an earlier operative program, PUPIL I. New and planned additions to the program are discussed and described, mainly those which permit a sub-goal or goal setting mode of operation, linguistic level behavioral control, and verbal skills. Various psychological and experimental topics bearing on the program are discussed and analyzed. Author (TAB)

N67-26920# Illinois Univ., Urbana. Dept. of Electrical Engineering.

ON THE REALIZABILITY OF QUASI-LINEAR SEQUENTIAL MACHINES

Szu-Chi Chang (Ph.D. Thesis) Feb. 1967 71 p refs
(Contract DA-28-043-AMC-00073(E)); Grant NSF GK-36)
(R-342; AD-648558) CFSTI: HC $3.00/MF $0.65

The realizability of quasi-linear sequential machines is studied in this thesis. For a given coding of the states of a sequential machine, a set of linear relations among the states can be found. A quasi-linear sequential machine preserves these linear relations under state transitions. A necessary and sufficient condition is first established for a completely specified coded sequential machine to have a quasi-linear realization with a minimum number of state variables. The theorem is then extended to uncoded sequential machines and involves obtaining, by an iterative method, a linear relation among the states and from this relation the generation of others until a number of linear relations sufficient to specify a state assignment has been obtained. A graphical representation of the theorem and an algorithm to synthesize an uncoded completely specified quasi-linear sequential machine from the flow table description are developed. Author (TAB)

N67-26951# Michigan Univ., Ann Arbor. Systems Engineering Lab.
MATHEMATICAL MODELS OF INFORMATION SYSTEMS Interim Report, Oct. 1965–Oct. 1966
Harvey L. Garner, Eugene L. Lawler and T. F. Diatkowski Griffiss AFB, N. Y., RADC, Jan. 1967 164 p refs
(Contract AF 30(602)-3546)
(IR-2; RADC-TR-66-813; AD-648823) CFSTI: HC $3.00/MF $0.65

This report is the second interim report of a three year study and investigation to develop mathematical models of information processing systems. The general area of research includes machine design, automata theory, and the application of mathematical models to problems in machine design. The areas of research described in this report are divided into seven sections: studies in the theory of algorithms, determination of isomorphism invariants for sequential machines, research on switching theory and combinations, research on a graph model for concurrent computation, consideration of statistical efficiency of algorithms for the state assignment of sequential machines, problems in characterizing and analyzing information processors, and the development of a switching theory model for computer control circuits. TAB

N67-26955# Naval Ordnance Lab., White Oak, Md. Physics Research Dept.
A MULTIPLE SPEED DELTIC CORRELATOR
Robert H. Davis and Arthur D. Delagrange 3 Jan. 1967 47 p refs
(NOLTR-65-222; AD-648972) CFSTI: HC $3.00/MF $0.65

A real time DELTIC Correlator system was constructed from digital logic modules. The system contains from one to four independent correlators, all of which operate at one of thirteen switch-selectable speeds. The thirteen speeds correspond to sample rates of approximately 38 kHz, 19 kHz, 9.6 kHz, etc., down to 9.4 Hz, and correlograms are generated with delays from 0 to 511 times the sample period. The second highest speed (19 kHz sample rate) is identical to the speed of the WOX-3A DELTICS. Author (TAB)

N67-26977# System Development Corp., Santa Monica, Calif.
LARGE CAPACITY LASER MEMORY FOR SPACEBORNE COMPUTERS
I. Dlugatch and S. Manus 13 Feb. 1967 11 p Presented at the 1st Ann. Princeton Conf., on Inform. Sci. and Systems, Princeton, N. J., Mar. 1967
(SDC-SP-2665; AD-648752) CFSTI: HC $3.00/MF $0.65

The report discusses the necessity for a spaceborne computer memory of at least 10 to the 7th power bit capacity. It is shown that such a device could minimize computer hardware and, at the same time, make feasible such devices as spaceborne random-multiple-access and synergetic satellites. Author (TAB)

N67-27264*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A METHOD FOR EXPANDING A DIRECTION COSINE MATRIX INTO AN EULER SEQUENCE OF ROTATIONS
George Meyer, Homer Q. Lee, and William R. Wehrend, Jr. Washington, NASA, Jun. 1967 16 p refs
(NASA-TM-X-1384) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A method has been developed for converting a matrix of direction cosines into an equivalent Euler sequence. For a desired rotational sequence, the analysis produced a set of five equations which require a sequential calculation of the Euler angles. The first angle is used to compute the second and the second is used to compute the third. For a given direction cosine matrix, the equations show that there are two Euler angle sets which will generate that matrix and can be considered to be the result of either a "positive" or a "negative" initial rotation. The results of the analysis will work throughout the entire 360° angle range and also for the singular cases. The results of the analysis have been generalized into two sets of equations, one of which applies to the classical or repeating sequences and the other to the nonclassical or nonrepeating sequences. These equations have been written as a Fortran IV subroutine and are presented in the appendixes of the report. Author

N67-27275*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPLICATION OF THE STORED-PROGRAM COMPUTER TO SMALL SCIENTIFIC SPACECRAFT
Rodger A. Cliff Washington, NASA, Jun. 1967 16 p refs
(NASA-TN-D-3988) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Stored-program computers have not yet been used in small scientific spacecraft. The evolution of spacecraft data systems indicates that inclusion of a computer is a logical next step. The computer would be used for four types of computation: buffering data, formatting data, redundancy removal, and parameter extraction. The most important advantage of using a computer is the flexibility obtained from using a stored program rather than a wired one. Author

N67-27337# Oak Ridge National Lab., Tenn.
A SYSTEM FOR BIOMEDICAL DATA MANAGEMENT (DATASYS). PART I: CONCEPTS AND FACILITIES
H. Katzan, Jr. Jan. 1967 45 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1693, Pt. 1) CFSTI: HC $3.00/MF $0.65

A hierarchically organized set of easy-to-use programs for use with data management problems is presented. The programming modules are under supervisory control of an executive program that routes work through the system. Datasys is designed to facilitate the following types of operations; storing, updating, and manipulating data; selecting, modifying, and sorting data for analysis; summarizing data for verification or reports; retrieving and collating files of experimental data; automating routine calculations; and plotting data. NSA

N67-27338# Oak Ridge National Lab., Tenn.
A SYSTEM FOR BIOMEDICAL DATA MANAGEMENT (DATASYS). PART IV: BIOPLOT
Kay L. Kannan Jan. 1967 17 p
(Contract W-7405-ENG-26)
(ORNL-TM-1693, Pt. 4) CFSTI: HC $3.00/MF $0.65

Bioplot, a system for biomedical data management, enables the user to plot graphs of discrete data without having to involve himself with the details of the electronic plotting equipment. Multiple curves may be generated on each graph. The user describes the work he wants performed with control statements and the plot tapes are generated by subroutines. Simple controls statements may be used to specify titles, type (i.e., Linear, Log, Semilog), symbols (for designating data points), source of data (i.e., bulk storage or system input data), plotting mode (i.e., connected or disconnected points), and a data smoothing option. Author (NSA)

N67-27339# Oak Ridge National Lab., Tenn.
A SYSTEM FOR BIOMEDICAL DATA MANAGEMENT (DATASYS). PART VI. BIOCALC
H. Katzan, Jr. Jan. 1967 35 p
(Contract W-7405-ENG-26)
(ORNL-TM-1693, Pt. 6) CFSTI: HC $3.00/MF $0.65

Biocalc is a computer program designed to relieve the scientist or technician of performing tedious calculations either by hand or with a desk calculator. Generally, the system contains provisions for reading in columns of data, performing calculations on them in column-wise fashion, and printing the data and results in a tabular format. More specifically, the program contains facilities for specifying variable names, constants, and column heading; for generating data internally; and for executing a wide variety of arithmetic operations and mathematical functions. Author (NSA)

N67-27411*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USE OF A STORED-PROGRAM COMPUTER ON A SMALL SPACECRAFT
R. A. Cliff *In its* Conf. on Adaptive Telemetry Jan. 1967 p 129–133 refs (See N67-27401 14-07)

The advantages which would result from making a small, programmable, general purpose digital computer a part of spacecraft electronics are discussed in relation to improved performance, and reduced time and manpower. The data systems aboard the Interplanetary Monitoring Platform (IMP) spacecraft are assessed and their deficiencies noted. A proposed basic spacecraft data system configuration is depicted which incorporates a centralized computer, and two separate encoders. The lower encoder, controlled by a fixed clock, operates in the conventional manner. The upper encoder is considered a significant feature, as it is synchronized to the spacecraft spin rate by sun pulses supplied from the optical aspect system. For each revolution of the spacecraft, the spin-synchronized encoder goes once through its format. Data can be collected on every spin; furthermore, the computer does the buffering between the variable spin rate and the fixed telemetry rate. A master lock that controls all subsystems that are not spin synchronized is cited as another improvement. M.G.J.

N67-27562*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METHODS OF PROCESSING SATELLITE DATA
Harry J. Goett and Edmund J. Habib Mar. 1967 50 p Presented at 16th Inter. Astron. Congr., Athens, Sep. 1965 Revised
(NASA-TM-X-55786; X-100-65-343) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Data processing requirements for space related observations are expected to increase sharply due to progressively broader transmission bandwidths and the associated increase in data rates per satellite. It appears that the capability of acquiring and processing these data has outstripped the rate at which it can be reduced, analyzed and interpreted. Adaption of automatic computing techniques to reduction and analytical processes is of greatest importance to handle the information explosion in space research. G.G.

N67-27581# Sandia Corp., Albuquerque, N. Mex.
COMPUTERIZED NUMERICAL INTEGRATION
D. G. Kitzinger Feb. 1967 21 p refs
(Contract W-7405-ENG-26)
(SC-RR-66-127) CFSTI: HC $3.00/MF $0.65

A computer subroutine was written which efficiently handles a large class of integrations. Most functions which can be expressed by combinations of Fortran statements can be integrated. Because the accuracy of the integration can be specified, costly overaccuracy in calculations is prevented. Singularities within the interval of integration are approached optimumly. Double and triple integrals with complicated limits of integration are within the scope of the computer technique. NSA

N67-27588# Argonne National Lab., Ill.
APPLIED MATHEMATICS DIVISION SUMMARY REPORT, JULY 1, 1965–JUNE 30, 1966
30 Jun. 1966 81 p refs
(Contract W-31-109-ENG-38)
(ANL-7280) CFSTI: HC $3.00/MF $0.65

A summary is presented of computer programs that were completed during the period. Also presented are summaries of activities in programming research and development, numerical and mathematical analysis, computer utilization in divisional research, computer engineering and computer systems, Argonne code center, and digital computer operations. Listings are included of publications, papers, seminars, and symposia. NSA

N67-27589# Los Alamos Scientific Lab., N. Mex.
SIMULATION OF THE SEL-810A COMPUTER ON MANIAC II (SELMA)
N. Metropolis, John R. Pasta (Illinois Univ.), and Malcolm Fraser 27 Feb. 1967 38 p refs
(Contract W-7405-ENG-36)
(LA-3640) CFSTI: HC $3.00/MF $0.65

The SEL-810A computer was simulated on MANIAC II; MADCAP was used as the programming language. The exercise has several objectives: a detailed knowledge of the logical structure of the SEL-810A and the preparation of programs would be possible; the suitability of MADCAP could be examined for this type of application. The two-pass assembler provided for the SEL computer was tested, and errors in the original versions were detected and corrected. An account is given of other experience. Author (NSA)

N67-27643*# Stanford Univ., Calif. Remote Sensing Lab.
FIELD INFRARED ANALYSIS OF TERRAIN—SPECTRAL CORRELATION PROGRAM. PART II: STANFORD ADAPTATION AND CORRECTIONS FOR USE ON LMSC PROGRAM ON IBM 7090–32K MEMORY COMPUTER. PART III: VOLTAGE DRIFT CORRECTION PROCEDURES
[1967] 49 p refs
(Grant NGR-05-020-115)
(NASA-CR-84486; Rept.-67-2) CFSTI: HC $3.00 CSCL 09B

Modifications and improvements to a spectral correlation program necessary for implementation on an IBM 7090 are presented. These adaptations are discussed for such areas as memory space conservation, input/output compatibility, plotting conversion, improvement of output, error messages, search package, buffer dimension inconsistencies, and interpolation changes. Included are an analysis of tape voltage drift attributed to a maladjusted tape recorder power supply, and the subsequent generation and use of a correction program. C.T.C.

N67-27689# Technische Hochschule Stuttgart (West Germany).
BEMAT PROGRAMMER'S REFERENCE MANUAL
P. C. Patton, H. A. Kamel, J. B. Spooner, N. W. Hubacker, G. M. Larssen et al Jan. 1966 91 p refs Revised
(Rept.-19) CFSTI: HC $3.00/MF $0.65

Details are given on Bemat, a general purpose matrix interpretive routine written to operate within the scope of the B package software of the Univac 1107 computer. The emphasis in Bemat is toward communication with other source languages, such as Fortran IV, and the general ease with which very large programs can be written and checked out using 1107 Exec II. It is pointed out that Bemat allows the use of Fortran IV and Sleuth II external subroutines and allows communication with Fortran subroutines via formal parameters, blank Common storage, and also magnetic tapes. The Bemat routine provides the programmer with more than 150 matrix operations. Should additional matrix operations be needed, the programmer can code in Sleuth II or Fortran IV and extend the system in a non-interpretive manner.

General descriptions are given of the storage allocations and the run deck make-up. An instruction repertoire is included, and programming examples are given in least squares curve fitting and a geometry problem. L.E.W.

N67-27699# Technische Hochschule Stuttgart (West Germany).
SELMA PROGRAMMER'S REFERENCE MANUAL
K. E. Buck Dec. 1965 76 p
(Rept.-26) CFSTI: HC $3.00/MF $0.65

An instruction manual is presented for the engineer who wishes to program in the Selma interpretive code. The matrix scheme, developed to facilitate programming of problems which can be formulated in matrix notation, is described. The input/output, arithmetical, data transport, control, and program termination instructions are given. N.E.N.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N67-26520*# Philco Corp., Santa Clara, Calif. Microelectronics Div.
INVESTIGATION OF CONTACT FAILURES ON RESISTORS
Final Technical Status Report
19 Oct. 1966 29 p refs
(Contract NAS5-9322)
(NASA-CR-84144) CFSTI: HC $3.00/MF $0.65 CSCL 09B

An investigation was conducted to determine and eliminate the incidence of defective electrical contacts of aluminum interconnecting films to polycrystalline silicon resistors. A solution was found, which was determined by combining critical geometry design with an improved alloy cycle. In general, the geometrical perturbation was the most significant factor in producing good electrical contact of the aluminum films to the silicon resistors. Author

N67-26745# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
INTEGRATED CIRCUITS FOR FIELDATA COMPUTERS
Quarterly Technical Report, 1 May–31 Oct. 1966
Ury S. Davidsohn and Faith H. Lee Mar. 1967 30 p ref
(Contract DA-28-043-AMC-01630(E))
(Rept.-4; QR-4; ECOM-01630-4; AD-648990) CFSTI: HC $3.00/MF $0.65

The report outlines the progress made in the development of the six-input gate and the present status of the flip-flop and line driver. Physical processes and material in process are discussed. Specific device parameters are considered. Transistor Saturation Resistance is derived and effects of material tolerance explained. Two methods of dielectric isolation which are being used are described. Pictures are submitted showing these methods and also showing actual units of the six-input gate in varying sequential process steps. Design of a linear amplifier is discussed. Author (TAB)

N67-26756# Fairchild Semiconductor Corp., Mountain View, Calif.
RADIATION STUDY ON MOS STRUCTURES
E. H. Snow, A. S. Grove, and D. J. Fitzgerald Jan. 1967 74 p refs
(Contract AF 10(628)-5747)
(SR-2; AFCRL-67-0062; AD-648236) CFSTI: HC $3.00/MF $0.65

The report examines in detail the effects of electron, X-ray, and ultraviolet radiation on oxidized silicon surfaces and Planar devices. Two permanent surface effects of ionizing radiation are distinguished: (i) The build-up of a positive space-charge within the oxide, and (ii) The creation of fast surface states at the oxide-silicon interface resulting in increased surface recombination velocity. The dependence of these effects on dose and dose rate, on bias applied during irradiation, and on structural parameters is discussed and a theory involving hole trapping is presented which accounts for the observed features of the space-charge build-up. Radiation-induced changes in the characteristics of MOS field-effect transistors, p-n junction diodes and pnp and npn transistors are reported and examined in terms of the above two effects. It is shown that the charge build-up causes shifts in the operating point of MOS transistors, catastrophic increases in the reverse current of p-n junctions, and large variation in their breakdown voltage. The increase in fast surface state density is responsible for the lowering of the transconductance of MOS transistors and, in combination with the space-charge build-up, for the degradation of the current gain in bipolar transistors. Author (TAB)

N67-26783# Dow Chemical Co., Midland, Mich. Plastics Dept.
THE EVOLUTION OF SHEATH CONSTRUCTIONS FOR COMMUNICATIONS CABLES
R. C. Mildner, W. F. Ropp and J. H. Snow Dec. 1966 19 p refs Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966
(AD-646537) CFSTI: HC $3.00/MF $0.65

Sheath constructions for multi-pair line communications cable, as developed in England, Germany and in the United States, are reviewed. It is concluded from the service experience reported that 'Bonded Jackets,' in which a metal tape shield is bonded to a plastic jacket, are equally suitable for paper and plastic-insulated cables. A theory of permeation through 'Bonded Jackets' is developed and reasons for discrepancies between theory and practice are discussed. Various aspects of the manufacture and splicing of 'bonded jacket' cable are considered. Experience in the fabrication of plastic/metal laminates over the past three years is given. The future of 'bonded jacket' cables also is discussed. Author (TAB)

N67-26788# Canada Wire and Cable Co., Ltd., Toronto (Ontario).
APPLICATION OF WELDED THIN METAL IN NEW COMMUNICATION CABLE DESIGNS
J. Derek, A. Busby, Guenther Lehnert, Louis E. Marrin, J. Vincent McBride et al Dec. 1966 12 p refs Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966 Prepared jointly with Hackethal-Draht- und Kabel-Werve Aktienges.
(AD-646538) CFSTI: HC $3.00/MF $0.65

The purpose of this paper describes new machinery designed for the application of welded thin-wall metallic cable coverings, reviews the characteristics of the welded structures and discusses several typical cable designs. TAB

N67-26790# AMF Thermatool, Inc., New Rochelle, N. Y.
THREE TYPES OF CABLE SHEATH PRODUCED BY HIGH FREQUENCY WELDING
Wallace C. Rudd Dec. 1966 14 p Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966
(AD-646544) CFSTI: HC $3.00/MF $0.65

With the THERMATOOL high frequency resistance welding technique, three basic types of cable sheath welds can be produced in a variety of metals. All of the welds are continuous and do not involve the addition of any metal. They are all produced at speeds from 60 to hundreds of feet per minute. The sheath produced can in most cases be corrugated, and long lengths can be made in a single continuous operation. Author (TAB)

N67-28798# Battelle Memorial Inst., Columbus, Ohio.
LOW-MODULUS MATERIALS FOR COAXIAL CABLE
K. M. Kell, Bailey Bennett, and P. B. Stickney 9 Dec. 1966 14 p Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966 Sponsored by Army Electron. Command
(AD-646530) CFSTI: HC $3.00/MF $0.65

Research was conducted to evaluate and develop new materials for both insulation and jacketing. The objective was to improve low-temperature flexibility without sacrifice of the desirable electrical and physical properties of existing cable materials. The conclusions are: (1) There is no single polymer available having the flexibility, resistance to deformation at elevated temperature, and electrical characteristics desired for insulation in coaxial cable for arctic use. (2) The desired balance of properties can be achieved by blending selected resins and elastomers. (3) Vulcanization of the polymer blend improves the physical properties permitting, for example, greater flexibility at low temperature with less sacrifice in high-temperature performance. However, the dielectric properties are adversely affected. (4) Blends consisting of approximately equal parts of high-molecular-weight polyisobutylene with a high-density ethylene copolymer have a good balance of physical properties and are extrudable. These blends appear promising for use as cable insulation and offer an improvement over existing materials. (5) Several new polymers in the polyurethane and ethylene copolymer class have demonstrated acceptable performance as cable jacketing and are more flexible at arctic temperatures than the polyvinyl chloride compositions presently used. (6) The best combination of flexibility, abrasion resistance, tear strength, and resistance to elevated-temperature deformation was exhibited by a millable, thermoplastic polyether urethane elastomer. TAB

N67-28799# United-Carr Fastener Corp., Cambridge, Mass. Exploratory Development Lab.
THE DESIGN OF PLATED COAXIAL CABLE
W. R. J. Brown and R. L. Komack 9 Dec. 1966 23 p Presented at 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966 Sponsored by Army Electron. Command.
(AD-646529) CFSTI: HC $3.00/MF $0.65

A theoretical model of the strain produced in a plated coaxial cable upon bending over a mandrel of given radius was developed. This theory was used to evaluate the importance of various parameters such as groove depth, groove pitch, and wall angle on the strain produced in the metal film. The groove depth was found to be of most importance. The remaining parameters can be chosen for manufacturing convenience. The electrical properties of the cable can be predicted by considering the cable as an eccentric coaxial transmission line and using the appropriate equations for characteristic impedance and attenuation. The fact that the eccentricity spirals about the center conductor seems to have no effect on the accuracy for frequencies up to 12 GHz. The validity of the theory was checked by flexing to destruction a number of cable samples with different groove depths. The data for all of these samples were found to plot on a single curve. This curve is used to compute the flex life of new cable designs. A computer program has been developed which includes all of these factors. TAB

N67-28881# Bendix Corp., Baltimore, Md. Radio Div.
THIN FILM MICROCIRCUIT INTERCONNECTIONS Final Report
Harold M. Greenhouse, Robert T. Galla, Theodore. H. Yaffe, Winfield W. Richardson, and William C. Vergara Jan. 1967 534 p
(Contract DA-28-045-AMC-01482(E))
(ECOM-01482-F; AD-647947) CFSTI: HC $3.00/MF $0.65

An evaluation was made of thin film interfacial interconnections and insulating crossovers. The interconnections were subjected to -55C, 125C, and 200C storage for 1000 hrs. 100 thermal cycles from -65C to 125C; and an accelerated aging at 240C (Interfacial interconnections) or 300C (crossovers). In addition, the interfacial interconnections were subjected to an operational life test and the crossovers to an operational humidity cycling test. The adhesion and compatability of the film combinations were studied. Eight interfacial combinations were investigated. The fabrication, measuring, analytical, and evaluation techniques are discussed. Based on these studied, several criteria have been established for the evaluation of interfacial interconnections. Based on these studied, several criteria have been established for the evaluation of interfacial interconnections. The electrical parameters studied were the d.c. and a.c. interfacial resistance, the rectification ratio, and the current carrying capability of the interconnection. Five combinations are equally acceptable and recommended for use. They are: (top conductor first) Cr/CrAu, CrAu/CrAu, Al/TaAl, CrAu/Cr, Al/Cr. Three are unacceptable, and not recommended for use. They are: TaAl/CrAu, Al/CrAu, CrAu/TaAl. The crossover geometry, along with the measuring and analytical techniques are discussed. The electrical parameters studied were: the d.c. insulation resistance, the 1000 Hz capacitance and dissipation factor, the d.c. breakdown voltage and the withstanding voltage. Several criteria have been established for the evaluation of crossovers. TAB

N67-28905# Autonetics, Anaheim, Calif.
RADIATION EFFECTS ON THIN-FILM MICROELECTRONICS Final Report, 15 Jul. 1965–14 Oct. 1966
A. F. Krueger and V. H. Strahan Feb. 1967 42 p refs
(Contract DA-28-043-AMC-01467(E))
(ECOM-01467-F; Rept.-5; AD-648742) CFSTI: HC $3.00/MF $0.65

The report describes the program to investigate the mechanisms of transient radiation effects on thin-film passive components. The effects under study included secondary emission effects, radiation-induced conductivity, memory and accumulated dose effects and damage by neutron irradiation. Radiation sources used were the 2 MeV and 600 keV flash X-ray machines, LINAC, and Fast Burst Reactor (FBR). A group of thin-film capacitors for studying the various effects was designed and fabricated. These capacitors were irradiated in air and in vacuum to determine the relative importance of the ambient environment on the total radiation-induced disturbance. Particular attention was paid to the effects of materials in the immediate proximity of the devices under study to determine methods of minimizing the effects of transient radiation. TAB

N67-28943# Amderex Electronic Corp., Hicksville, N. Y.
CONSTRUCTION OF A NON-GRIDDED, FIELD EFFECT TUBE FOR USE IN SONAR APPLICATIONS Final Quarterly Report, 1 Oct.–31 Dec. 1966
Jan. 1967 70 p
(Contract NObsr-93384)
(QR-6; AD-648847) CFSTI: HC $3.00/MF $0.65

A prototype of a sonar tube capable of generating several times the power requested was developed. Life tests show that the operating conditions are compatible with adequate life even at these high power levels. Advantages of such a tube over tubes presently used are: (1) Highly increased reliability because of the absence of grid emission - shorts - characteristic drift - cathode poisoning. (2) Non-brittle cathode for long life and insensitivity to large line voltage fluctuations. (3) Tetrode characteristics without the need for a separate screen supply. (4) Low drive power and very high efficiency. (5) Cool tube operation; simple conduction cooling possible. (6) Tube more rugged by an order of magnitude than any existing electron tube. Compared with semi-conductors, the Field Effect Tube offers the following advantages: (1) Inexpensive. (2) One unit for full power. (3) Conduction cooling possible. (4) Insensitive to wide variations of load impedance. (5) Transient overload capability. TAB

N67-27002# Harry Diamond Labs., Washington, D. C.
EFFECTS OF PULSE NUCLEAR RADIATION ON STEP RECOVERY DIODES
David T. Lokerson Jan. 1967 29 p ref
(HDL-TR-1339; AD-648380) CFSTI: HC $3.00/MF $0.65

The nuclear radiation effects on the reverse breakdown voltage, reverse leakage current, series resistance, transition time, storage time, and carrier lifetime of two step recovery diodes were measured. Twenty-millisecond triangular radiation pulses with fluences, above 10 KeV of 6.5 × 10 to the 11th to 7.5 × 10 to the 13th power neutrons per square centimeter were used to provide a total fluence of 2.6 × 10 to the 14th power. Of the diode parameters mentioned, only the minority carrier lifetime (which is a fundamental parameter that determines the storage time) was measureably affected by the radiation. A simple radiation damage model was used to generate a function relationship between the carrier lifetime and neutron fluence. The theoretically predicted lifetimes were so nearly equal to measured ones over the range of lifetime and fluence levels tested, that accurate, real-time, remote-reading fluence measurements could probably be made using this step recovery diode as a transducer. Author (TAB)

N67-27006# Rome Air Development Center, Griffiss AFB, N. Y.
REACTIVELY SPUTTERED CERMET RESISTOR Final Report, May 1965–May 1966
Clyde H. Lane and John P. Farrell Jan. 1967 33 p refs
(RADC-TR-66-783; AD-648018) CFSTI: HC $3.00/MF $0.65

A dual cathode sputtering technique for creating thin cermet films is described in this report. This technique was actually used to produce four types of mixtures: gold-tungsten oxide, platinum-tungsten oxide, platinum tantalum oxide, and gold tantalum oxide. Various resistor parameters are presented for all of the films. However, the emphasis is on the gold tantalum mixtures which gave a zero temperature coefficient at approximately 6 to 8 thousand ohms per square sheet resistivity. A summation is presented on this work and suggestions for further efforts in this field. Author (TAB)

N67-27161# Picatinny Arsenal, Dover, N. J. Plastics Technical Evaluation Center
ENCAPSULATION OF ELECTRONIC PARTS IN PLASTICS—A REVIEW
Arnold E. Molzon Feb. 1967 67 p refs
(PLASTEC-29; AD-648420) CFSTI: HC $3.00/MF $0.65

The advances and trends in the plastics encapsulation of electronic parts and circuits are reviewed. In less than 20 years this industry has developed into a high production operation. Included in this report are: types of plastics used, material requirements and material consumption. Known material suppliers and equipment suppliers are listed and their products identified. Also tabulated are 47 pertinent specifications, 111 contracts (with reports), and 53 government laboratory reports. These reflect the materials research and development in the Department of Defense, in NASA, and in industry. The availability of information is also discussed. The report contains a bibliography of 207 items on encapsulation. TAB

N67-27273*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRO-OPTIC AND MAGNETO-OPTIC MODULATORS
E. Hirschmann Washington, NASA, Jun. 1967 14 p refs
(NASA-TN-D-3775) CFSTI: HC $3.00/MF $0.65 CSCL 09A

This report describes research in the use of gallium arsenide (GaAs), gallium phosphide (GaP), and potassium tantalate niobate (KTN) crystal materials for electro-optic light modulators. Gallium arsenide, which has the potential to modulate at wave lengths as great as 16 microns, was found the most useful for laser modulation. Yttrium iron garnet (YIG) is also examined for use as a wideband magneto-optic modulator. A wideband YIG modulator has recently been developed which represents a great improvement over other magneto-optic modulators. Author

N67-27365*# ITT Industrial Labs., Fort Wayne, Ind.
RESEARCH IN THE DEVELOPMENT OF AN IMPROVED MULTIPLIER PHOTOTUBE Final Report
F. H. Barr and E. H. Eberhardt 16 Nov. 1966 79 p refs
(Contract NASw-1038)
(NASA-CR-84406; ITTIL-66-1058) CFSTI: HC $3.00 CSCL 09A

A summary of data on the cascade operation design as a method of controlling low energy electrons in the region of the defining aperture and dynode one is presented. A new dynode one design is also briefly evaluated. The dark noise characteristics of certain photocathode type multipliers were studied by cathode cooling techniques. The counting of tubes in which the instantaneous effective cathode diameter was increased by a new tube design to about 0.4 to 0.5 inch was investigated. Counting properties and increased effective photon counting efficiencies of tubes especially designed for enhancement of the cathode quantum efficiency by means of multibounce optical techniques, were also investigated. Pulse response properties were measured on other counting tubes. L.S.

N67-27438*# Westinghouse Electric Corp., Elkridge, Md. Molecular Electronics Div.
TESTS AND INSPECTION FOR PROCESS CONTROL OF MONOLITHIC CIRCUITS
Edward Spangenberg and Robert March 25 Feb. 1967 257 p
(Contract NAS8-21008)
(NASA-CR-84433) CSCL 09A

Guidelines are presented for auditing suppliers of integrated circuits. A survey check list of various key functions within the supplier's organization is provided, and assembled in such a way that a numerical rating can be affixed to each audit item and a score can be developed. Wafer process functions and their control are discussed in detail, and various key requirements which should be realized in order to maintain homogeneity are outlined. Some of the techniques which may be used in controlling the operations which take place after wafer development are highlighted, and include such functions as wafer probe, wafer separation, die sort, die mount, precap visual, and test. C.T.C.

N67-27472# Boeing Co., Seattle, Wash.
DETAILED RADIATION EFFECTS STUDY ON FOUR JUNCTION-ISOLATED MICROCIRCUITS Final Report, Nov. 1965–Jun. 1966
W. C. Bowman and R. S. Caldwell Griffiss AFB, N. Y., RADC Jan. 1967 79 p refs
(Contract AF 30(602)-3585)
(RADC-TR-66-718; AD-648820) CFSTI: HC $3.00/MF $0.65

Four circuits, including three differential amplifiers and one line driver, have been studied in pulsed ionizing radiation at rates ranging from 10 to the 7th power rads/sec to 3 x 10 to the 11th power rads/sec and in a neutron environment to fluences up to 2 x 10 to the 15th power n/sq cm. All of the circuits used junction isolation. The isolation junction photocurrent dominated the response in each case. One of the amplifiers experienced latchup at approximately 1 to 5 rads prompt dose when its isolation junction went into second breakdown. Neutron irradiation brought about fatal degradation at fluences of the order of 10 to the 15th power n/sq cm due to changes in the minority carrier lifetime in the base region of the circuits' transistors. There is evidence of surface effects being present in the amplifiers; however, this mechanism of degradation is secondary to the bulk damage. Author (TAB)

N67-27473*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FLAT CONDUCTOR CABLE MANUFACTURE AND INSTALLATION TECHNIQUES
Wilhelm Angele [1966] 45 p refs Presented at 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966
(NASA-TM-X-59697; AD-646533) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The various types of flat conductor cables and their design and manufacture are discussed. Cable termination techniques, interconnection hardware, cable harness manufacture, and installation methods are described. The results of an extensive flat cable installation exercise in the Saturn S-IVB stage are presented. Present plans are for design studies on the Apollo application systems. Also, further cable and connector hardware is being developed for higher frequency, high power, and connector pin function change requirements. Author (TAB)

N67-27543*# Radio Corp. of America, Princeton, N. J.
LAMINATED FERRITE MEMORY FABRICATION
C. Wentworth Sep. 1965 11 p
(NASA-CR-84457) CFSTI: HC $3.00/MF $0.65

The procedures for preparing the Ferrite powder ($Zn_{0.45}Mg_{0.55}Fe_{1.55}Mn_{0.45}O_4$) B material; and the ferrite slurry, are outlined. The other steps in the fabrication of the laminated ferrite memory plane: 1) ferrite sheet manufacture, 2) conductive line fabrication, 3) laminating, and 4) firing, are also described. The composition of Ferrite B has the following characteristics: coercive field, H_c=0.4 Oe; switching coefficients, S_w=0.3 Oe–μsec; remnant flux density, B_r=1200 gauss; squareness, S=0.9; and curie temperature, T_c=110°C. Another composition, Ferrite A is also available. L.S.

N67-27566*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DESIGN OF A STATUS MONITOR USING COST-EFFECTIVENESS ANALYSIS
Philip B. Pease May 1967 34 p
(NASA-TM-X-55793; X-521-67-208) CFSTI: HC $3.00/MF $0.65 CSCL 09F

This document describes in detail how each step of the design technique was accomplished to produce the design of a status monitor for the telemetry portion of a ground station. The telemetry installation considered in this document was proposed for the new Network Test and Training Facility (NTTF) located at the Goddard Space Flight Center in Greenbelt, Maryland. A basic functional diagram of this installation is included. Author

N67-27649*# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
PHOTON-COUPLED ISOLATION SWITCH Quarterly Report 1 Oct.–31 Dec. 1966
E. L. Bonin 31 Dec. 1966 16 p Prepared for JPL
(Contracts NAS7-100; JPL-951340)
(NASA-CR-84498; TI-03-67-39) CFSTI: HC $3.00/MF $0.65 CSCL 09A

A new type of integrated circuit switch is being developed. This device, called the photon coupled isolation switch, uses internal photon generation and detection techniques to provide electrical isolation between the driving sources and all other terminals of the switch. The switch combines a monolithic silicon (Si) integrated circuit, a gallium arsenide (GaAs) photon emitting diode, and a silicon phototransistor in a single integrated circuit flat package. The integrated circuit delivers bias to the photon emitting diode and, with DTL circuitry, provides for up to 10 inputs. The emitting diode is optically coupled to the electrically-isolated phototransistor which provides the output switch terminals. Work included additional evaluation of phototransistor leakage and measurements of thermal resistance and noise transmissibility of the emitting diode-phototransistor pair. Under investigation are modifications of the driver circuit which will allow use of improved, lower-forward-voltage-drop GaAs emitting diodes and provide lower photon generated leakage in the phototransistor for the off-condition. Author

N67-27651*# Boeing Co., Seattle, Wash. Launch Systems Branch.
METALLURGICAL ANALYSIS OF MBC450-31 HERMETIC ELECTRIC CONNECTOR
C. B. Schwartz [1966] 14 p refs
(Contract NAS8-5608)
(NASA-CR-84496; T5-6539-79) CSCL 09A

A metallurgical analysis was conducted of the spring clips of a MBC 450-31 connector assembly. Analysis found no metallurgical defects. However, contact pins were found to be contaminated with an adhesive used to hold a silicon rubber insert in place on the connector. Author

N67-27685 Polish Academy of Sciences, Warsaw.
A NON-OVERLOADING HIGH STABILITY LINEAR PULSE AMPLIFIER [LINEARNY NIEPRZECIAZALNY WYSOKOSTABILNY WZMACNIACZ PODWOJNIE ROZNICZKUJACY]
Ryszard Bayer 1966 14 p refs In POLISH; ENGLISH summary
(INR-746/III/E)

A non-overloading high stability linear pulse amplifier has been built. Its operation principle solution and characteristics are described. Some results of measurements are given. Author

N67-27750# Autonetics, Anaheim, Calif.
THE STORY OF MICROELECTRONICS—FIRST, SECOND, AND FUTURE GENERATIONS
Martha Smith Parks 1966 132 p refs
(P3-75/317)

The history of the development of microelectronics is traced, and its applications in space, defense, commerce, and industry are pointed out. The concepts of reliability, maintainability, and availability are defined and their relation to microelectronics is discussed. The physical advantages of microelectronics, including small size, light weight, and reduced power and heat dissipation requirements, are noted. The different microelectronics techniques, i.e., digital, radio frequency, and linear are described and their various applications are discussed. Details are given on metal oxide semiconductor technology, improvements to first-generation devices and packaging, and joining. The operations of a major microelectronics systems organization are reviewed with emphasis on the areas of research, development, design, production, purchasing, and using. The future potentialities of microelectronics are also mentioned, and consideration is given to single crystals, ferrites and YIG, planar annular varactors, optical waveguides, analog-to-digital converters, and micromemories. A glossary of microelectronics terms is also included. L.E.W.

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N67-28606# Illinois Univ., Urbana. Coll. of Engineering.
COORDINATED SCIENCE LABORATORY
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 79–86 refs
(See N67-28601 14-34)

Laboratory activities reported include programs in plasma and surface physics, applied physics, information theory and retrieval, systems theory, space science, and the design and utilization of computers in engineering systems. Summary details are also presented on switching and control systems, communication networks, vacuum techniques, programmed logic for automatic teaching operation (PLATO), system for instructional response analysis (SIRA), and rocket studies of the ionosphere. R.L.I.

N67-26606# Illinois Univ., Urbana. Coll. of Engineering.
ELECTRICAL ENGINEERING
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 87–110 refs (See N67-26601 14-34)

Electrical engineering progress is summarized for the fields of aeronomy, antennas and electromagnetic theory, biological computers, biophysics in engineering, charged particles, control systems, cybernetics, electrophysics, electrosonics, gaseous electronics and plasmas, ionospheric propagation, network analysis and synthesis, optical electronics, lunar reflections, radio astronomy, radiolocation, semiconductors, and solid state electronics. R.L.I.

N67-26748# Northwestern Univ., Evanston, Ill. Information-Processing and Control Systems Lab.
ON OPTIMAL LINEAR SMOOTHING THEORY
James S. Meditch Mar. 1967 29 p refs
(Contract N00014-66-C0020-A03)
(TR-67-105; AD-649259) CFSTI: HC $3.00/MF $0.65

The algorithm for generating the smoothed estimate x(t/t + T) of the state x(t) of a continuous linear system, where t is continuous time, T is a positive real constant, and t + T is the time of the most recent measurement, is developed. A linear matrix differential equation whose solution gives the covariance matrix of the smoothing error x(t/t + T)−x(t/t + T) is then derived. Computational aspects involved in mechanizing the algorithm are discussed in terms of the algorithms dependence on the solution of the prediction, filtering, and fixed-point smoothing problems. The results are then discussed in terms of the classical Wiener smoothing problem. Author (TAB)

N67-26843# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON SIMULATING CERTAIN RECENT MATHEMATICAL PROBLEMS
V. I. Ivanenko *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 33–45 refs (See N67-26841 14-08)
(MT-64-264)

A method for simulating mathematical problems in a computer complex is considered, and some peculiarities in combining a dc analog computer with a general purpose parallel action digital computer are discussed. The problems considered are associated with determining the algorithm of automatic seeking of optimum control, or the synthesis of self-adjusting systems. The general scheme of the numerical solution is based on analyzing sectors of phase trajectories of the system of equations using the optimization principle. The calculating algorithm is described, along with the method of programming. M.G.J.

N67-26860# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE AUTOMATIC SYNTHESIS OF OPTIMUM SYSTEMS OF AUTOMATIC CONTROL
A. A. Fel'dbaum *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 309–333 refs (See N67-26841 14-08)

A block diagram of an automatic control system is examined in conjunction with the problem of optimum system synthesis. The problem is then reduced to developing a controller which assures optimum processes in a system with a given controlled object; generally, the method of connecting this object with the controller is given. An equipment complex is proposed for automatic synthesis. The apparatus is considered useful in determining the optimum block diagram, the algorithm, and the program for the case when the minimized function of the optimality criterion has only one minimum. Variational methods of automatic synthesis are also assessed. M.G.J.

N67-26979# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MATHEMATICAL CONDITIONS OF PHYSICAL FEASIBILITY IN INVARIANT AUTOMATIC AND GYROSCOPIC SYSTEMS
S. A. Babushkin 6 Dec. 1966 37 p refs Transl. into ENGLISH from the publ. "Teoriya Invariantnosti v Sistemakh Avtomaticheskogo Upravleniya" Moscow, Izd. "Nauka", 1964 p 65–83
(FTD-MT-65-565; TT-67-61329; AD-648889) CFSTI: HC $3.00/MF $0.65

Systems of differential equations describing the movement of automatic control systems and gyroscope systems obey specific mathematical conditions, called the necessary mathematical conditions of physical feasibility in this report, since they must be checked in the process of synthesis of differential equations of motion for meters and computers in these physical systems. The mathematical conditions shown can also be used with the solution of different analysis problems. The purpose of this work is to formulate the necessary mathematical conditions of physical feasibility of dynamic systems and to show the use of the first and second groups of these conditions for the solution of concrete technical problems which present a theoretical interest. Author (TAB)

N67-27018# Syracuse Univ., N. Y.
SOME APPLICATIONS OF LINEAR DIFFERENTIAL VECTOR EQUATIONS
F. M. Reza Griffiss AFB, N. Y., RADC, Feb. 1967 58 p refs
(Contract AF 30(602)-3853)
(RADC-TR-66-595; AD-648247) CFSTI: HC $3.00/MF $0.65

Progress in the field of functional analysis along with the advent of modern computers has updated the classical approach for solving dynamical problems of electrical circuits and systems. Linear differential equations appear abundantly in the study of electronic circuits and systems. The method presented in this report for solving these equations is based on the concept of a linear space and its mapping. Vectors of linear differential equations, norm of the input and output spaces, initial condition space, solution space, and matrices of differential equations are fully discussed. A number of carefully selected examples are inserted. Further applications of the theory in the context of State Space Technique, Stability, Controllability and Observability are given in a supplementary report. This report along with its companion report should hopefully present a self-contained introduction to the study of vectors of linear differential equations and dynamical systems. Author (TAB)

N67-27082*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
MOLECULAR BEAMS
In its Res. Lab. of Electron. 15 Apr. 1967 p 1–4 refs (See N67-27081 14-23)
(Contract DA-28-043-AMC-02536(E))

A new beam tube possessing a recirculating oven was completed during this period and the construction of a low-frequency electronics system reported. A diagram depicts the atomic clock and the frequency-control loop response. The effects of various types of noise on clock stability are also reported. R.L.I.

N67-27086*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
SOLID-STATE MICROWAVE ELECTRONICS
In its Res. Lab. of Electron. 15 Apr. 1967 p 27–31 ref (See N67-27081 14-23)

Solid state microwave electronics developments are reported briefly in relation to high dynamic range techniques, high-power varactor multipliers, and computer design of varactor circuits. A phase detector with nearly 140 dB of dynamic range was completed, and preliminary results are reported available on both a linear and a logarithmic amplifier. Preliminary measurement of high-power, punch-through varactors in a new test jig at 500 MHz indicate cutoff frequencies of as much as a factor of 2 higher than previous types. Two analysis programs for high-order punch-through varactor multipliers were developed during the past quarter. R.Li.

N67-27100*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
DETECTION AND ESTIMATION THEORY
In its Res. Lab. of Electron. 15 Apr. 1967 p 249–265 refs (See N67-27081 14-23)
(Contract DA-36-039-AMC-03200(E))

In application to a detection and estimation theory, equations are derived to specify the nonlinear interval, and a technique is reported for determining the optimum nonlinear realizable filter from the equations specifying the nonlinear interval estimator. In addition, application is made of the technique of titled probability distributions to the problem of evaluating the performance of optimum detector for Gaussian signals received in additive Gaussian noise. R.Li.

N67-27124 Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
A TYPE OF A RANDOM NUMBER GENERATOR [GENERATORE DI NUMERI A CASO]
C. Felici and P. Gricia 12 Nov. 1966 10 p In ITALIAN; ENGLISH summary
(ISS-66/43)

This report presents a random number generator circuit, based on the use of the noise of an amplifier which is sent to a pulse shaper circuit, in such a way to randomly vary the duration of the signal given by the circuit (1.8 ms on the average) of about 10%. This signal puts "on" a gate circuit at the input of which is always a signal of 10 MHz frequency. In this way the wave train duration at the output of the gate, and therefore the number of the pulses in it, vary randomly. Author

N67-27181# Joint Publications Research Service, Washington, D. C.
SELF-ORGANIZING CONTROL SYSTEMS
V. A. Grubov, A. G. Ivakhnenko, and B. Yu. Mandrovskiy-Sokolov 17 Apr. 1967 151 p Transl. into ENGLISH from the book "Promyshlennaya Kibernetika" Kiev, Naukova Dumka, 1966 p 288–435
(JPRS-40657; TT-67-31301) CFSTI: HC $3.00/MF $0.65

The subject of cybernetics and analytical-experimental investigation models is considered in a discussion of self-organizing control systems. The problem of extremal control of production processes is described as one of the most important in engineering cybernetics. Such topics as differential extremal regulators, the principle of building sensors, analytical synthesis of the correlation corrector arrangement, the recognition system, control of cyclic processes, and the multiple-row perceptron are examined. S.P.

N67-27293*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PULSE-TRAIN GENERATOR FOR ROCKET CAMERA
Robert S. Lee Washington, NASA, Jun. 1967 10 p
(NASA-TM-X-1390) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The design of a solid-state pulse-train generator to control shutter and film-advance timing for rocket-borne camera experiments is described. The major design objectives were simplicity, flexibility, accuracy, and low power consumption. The timing cycle commences when power is applied, and the circuit recycles continuously until the power is shut off. For experiments in which continuous recycling is not required, the clock can be "clamped"; or binary logic can be added to obtain any number of cycles desired. Author

N67-27304*# Honeywell, Inc., St. Paul, Minn. Systems and Research Div.
DESIGN OF A LOAD-RELIEF CONTROL SYSTEM Final Report, 1 May 1965–1 May 1966
L. D. Edinger, G. B. Skelton, C. R. Stone, M. D. Ward, and G. D. White 9 May 1966 423 p refs
(Contract NAS8-20155)
(NASA-CR-61169) CSCL 09C

The objective of this study was to develop a load-relief controller design technique for a launch booster disturbed by winds. The objective was met by formulating the load-relief problem as a stochastic minimization problem. The incident winds and corresponding booster responses were described as random processes, and an event of mission failure was defined. The event of failure is that one or more responses of concern will fall outside preselected limits at burnout or during the flight. The stochastic problem was to minimize an upper bound on the likelihood of occurrence of this event. The stochastic problem was formulated in a manner that permitted its solution by application of known optimization theories. Its solution yields a linear finite-time controller with time-varying gains. The design procedure consists of solving this problem simplifying the resulting optimum controller. The missile was assumed rigid, and its deviations from a nominal (no wind) trajectory were assumed to be linear functions of wind and gimbal inputs. The vehicle was assumed to fly for 150 seconds, launch to first-stage burnout, and the goal of control was to achieve final errors within prescribed limits. Author

N67-27386 Joint Publications Research Service, Washington, D. C.
DETERMINATION OF THE REGULARITY OF AN AUTOMATON BY ITS CANONICAL EQUATIONS
B. M. Kloss and V. A. Malyshev 16 Mar. 1967 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 172, no. 3, 1967 p 543–546
(JPRS-40280; TT-67-30926) CFSTI: $3.00

Autonomous automata with a finite set of Ω states containing N elements are investigated. Each such automaton is represented as an into transformation of the set Ω. The automaton is conditionally called regular if it realizes a one-to-one transformation of Ω. The problem of how to discover whether the automaton is regular or not by its equations is solved, and its complexity is evaluated by a specific class of mathematical proofs. L.S.

N67-27558# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
STATISTICAL CONTROL SYSTEM DESIGN Technical Report, May 1965–May 1966
R. Reiss, J. Mendelsohn, A. Van Gelder, and G. Taylor Wright-Patterson AFB, Ohio, Research and Technol. Div. Oct. 1966 110 p refs
(Contract AF 33(615)-2431)
(AFFDL-TR-66-83; AD-648023) CFSTI: HC $3.00/MF $0.65

The report discusses the performance of optimal control systems with random parameters. The plants treated are described by time-invariant ordinary differential equations whose parameters are random variables with known distributions. The control law

remains fixed as the nominal optimal control, and it is assumed known. Because the parameters of the differential equations are random variables, the performance is a random variable and can only be described in terms of its statistics. Several methods of evaluating the ensemble statistics are presented and compared. Alternatives better suited to stochastic systems are given to the classical notion of sensitivity. Numerical results are presented for specific examples, and the computer programs used in the study are discussed. The report also includes an analysis of a particular optimal stochastic control problem, to indicate some of the difficulties involved in deriving optimal stochastic control laws. Author (TAB)

N67-27613*# National Aeronautics and Space Administration. Goddard Space Flight Cener, Greenbelt, Md.
TUNNEL DIODE LOW-LEVEL DETECTION
W. F. Gabriel Washington, NASA, Jun. 1967 45 p refs
(NASA-TN-D-3905) CFSTI: HC $3.00 CSCL 09A

An analysis of tunnel diode low-level detection is presented for the purpose of explaining some of the unusual detection characteristics that occur under certain bias conditions. For example, in the vicinity of its inflection bias point, a tunnel diode exhibits a discriminator-like rectification behavior with two sensitivity peaks. When biased at one of these peaks, the diode is capable of unusually high sensitivities, at least an order of magnitude better than the sensitivity of any other known diode. The resultant gain-bandwidth (or sensitivity-bandwidth) limitations of the detector are discussed. Unusually high sensitivities are also possible at the lower microwave frequencies when the tunnel diode is biased at its peak current point. A knowledge of the diode static characteristics, the reflection coefficient, and the video circuit permits an accurate analytical evaluation of the sensitivity performance of any tunnel diode, and calculations are carried out for an example diode and compared with measured data. A specific comparison of the relative sensitivity performance of the example tunnel diode vs. a hot carrier diode is also presented. Author

N67-27619*# General Precision, Inc., Little Falls, N. J.
STABILITY OF ATTITUDE CONTROL SYSTEMS ACTED UPON BY RANDOM PERTURBATIONS
B. Friedland, F. E. Thau, V. Cohen, J. Ellis, and P. E. Sarachik Washington, NASA, May 1967 136 p refs
(Contract NAS12-48)
(NASA-CR-731) CFSTI: HC $3.00 CSCL 09C

The problem of selecting analytical models for the random disturbance processes is assessed, several obvious sources of the disturbances are characterized, and the statistical parameters associated with these sources are estimated. The Poisson impulse process, considered as the starting point for the models, is described. Fundamental equations for the evolution of Markov processes are derived. The confinement probability, i.e. the probability of not leaving a given region in state space for a specified time interval starting at a point in this region, is examined, and analytical and numerical techniques for estimating this probability and the half-life and mean confinement time are given. These techniques are used to calculate several first- and second-order linear and nonlinear systems, and their implications as regards a typical space vehicle are discussed. The computer program used for the Monte Carlo simulations is described, and an annotated bibliography is included. M.G.J.

N67-27670*# California Univ., Los Angeles. Dept. of Engineering.
VARIABLE TIME OPTIMAL CONTROL
R. A. Niemann Apr. 1967 104 p refs
(Grant NsG-237-62)
(NASA-CR-84510; Rept.-66-633) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A new approach to the variable time problem is considered which involves determining the optimum and solving the boundary conditions for a fixed time before varying the time to get an improved optimum. A brief mathematical treatment of Pontryagin's maximum principle is given and the Hamiltonian H=0 condition for variable time optimum is derived. Sequential optimization and quasilinearization algorithms for solving the fixed time problem are described. A numerical example is given and computational results for each algorithm are discussed. These algorithms are extended to the variable time problem by a computational algorithm which uses only the H=0 necessary conditions and solves the variable time problem as a series of fixed time problems. This method is extended by adding sufficient conditions for a local minimum over all final times of the minimized performance criterion for various fixed final times. The variable end point problem is considered and a computational algorithm using the transversality condition is developed. In using this condition, the same kind of problems are encountered as in using the H=0 condition. R.N.A.

N67-27671*# California Univ., Los Angeles. Dept. of Engineering.
OPTIMAL CONTROL OF DISTRIBUTED PARAMETER SYSTEMS USING MULTILEVEL TECHNIQUES
David Arthur Wismer, Jr. Apr. 1967 131 p refs
(Grant NsG-237-62)
(NASA-CR-84511; Rept.-66-55C) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Some multilevel control techniques for the optimization of nonlinear static and dynamic systems are reviewed with emphasis on the convergence properties of various forms of second level controllers including a Gauss–Seidel type controller. The classes of optimal control problems which can be attacked by a multilevel approach are defined. A fairly general semidiscrete model is developed. The necessary conditions are developed for the special case of a nonlinear diffusion equation with quadratic cost functional in order to fix ideas. The pros and cons of using multilevel techniques to solve the optimal control problem for distributed parameter systems are discussed along with some controllability questions. A critique on various second level controllers is given together with some miscellaneous topics such as state inequality constraints and time discretization. Example problems using the ideas of multilevel control are formulated and their numerical results are presented. The computer program and the quasilinearization method used in obtaining subsystem solutions are described. R.N.A.

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N67-26544*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
NITROGEN TETROXIDE DISPOSAL UNIT COMBUSTION PRODUCTS
Irwin D. Smith Washington, NASA, May 1967 8 p ref
(NASA-TN-D-3965) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A test program was conducted to determine the identity of the combustion products released to the atmosphere by the units utilized to dispose of nitrogen tetroxide. Samples of the combustion products were collected and analyzed by infrared spectroscopy. The samples obtained when the unit was operated in the

normal, slightly fuel-rich mode showed the detectable combustion products to be carbon dioxide, water vapor, and unburned propane or other carbon hydrogen bond-containing materials. Author

N67-26557*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THEORY AND TESTING OF A SPACE RADIATOR SIMULATOR FOR A SNAP-8 GROUND TEST FACILITY
Andrew A. Schoenberg, Raymond S. Bilski, and Pierre A. Thollot Washington, NASA, May 1967 45 p refs
(NASA-TM-X-1375) CFSTI: HC $3.00/MF $0.65 CSCL 18N

The radiator simulation utilized an existing finned-tube heat exchanger cooled by a controllable airflow. The radiator model consisted of parallel finned tubes to which the waste heat of the Rankine cycle was transferred by circulating liquid metal. The same liquid metal, at the flight temperature levels and flow rates, circulated through the convectively cooled heat exchanger of the simulator facility. The method of simulation was to automatically adjust the coolant airflow of the heat exchanger so that its liquid metal outlet temperature was at all times the same as that of the radiator model. Equations for the control of coolant air were derived by linearized analysis of the radiator model and heat-exchanger heat-rejection characteristics. These equations were used in the form of a feedforward (open loop) and feedback controller and were implemented on an analog computer. Feedback integral control on outlet-temperature error was used for accurate steady-state control. Feedforward or open-loop control based on liquid metal flow and inlet temperature was necessary for controlling the outlet temperature time response to more rapid disturbances of these two input variables. Testing showed that the radiator was accurately simulated for steady-state or very slow transient operation. Author

N67-26640*# Cosmic, Inc., Washington, D. C.
INVESTIGATION OF CHARGED COLLOID BEAMS FOR ELECTROSTATIC PROPULSION Final Report
D. Gignoux and H. Anton May 1967 54 p refs
(Contract NAS3-7924)
(NASA-CR-54702; Rept.-165) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A facility for testing charged colloid sources has been built. The pumping speed in the vacuum chamber is sufficient to make possible operation with beams of glycerol up to several milligrams/second. Propellants consisting of mixtures of glycerol or Octoil with agents intended to increase the conductivity of the liquid have been tried in the system. Instrumentation adequate to measure beam currents, mass flow, and thrust has been developed and built, and is working satisfactorily. A spinning nozzle was used for most tests with the propellant atomized at its edge. The maximum values obtained with glycerol were: Charge-to-mass ratio, 2,000 coulomb/kilogram; current, 2 milliamperes; thrust, 125 milligrams. On most tests, the efficiency was 25 percent. It has been determined that colloids of this type are changed by a corona-like mechanism. Some tests with the liquid coming through a hollow needle instead of a nozzle led to the same conclusion. Author

N67-26648# North American Aviation, Inc., Los Angeles, Calif.
MULTIPLE SHAKER GROUND VIBRATION TEST SYSTEM DESIGNED FOR XB-70A
R. G. North and J. R. Stevenson *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 55–70 refs (See N57-26642 14-32)

Equipment developed for and employed in the XB-70A ground vibration test, including the 24-shaker vibration excitation system, the 100-channel data acquisition system capable of automatic recording on IBM punched cards, and the low-frequency air vehicle suspension system, are briefly described. Special operating procedures are also described. Author

N67-26652# Autonetics, Anaheim, Calif.
DESIGN TECHNIQUES FOR HORIZONTAL DRIVERS
Fred C. Tolleth *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 101–112 refs (See N67-26642 14-32)

Design requirements, analysis for a large cast horizontal driver (or adaptor) used with a Ling-249 vibration exciter, and pertinent data for use with the design are presented in this paper. A practical analysis is offered for a single- and two-degree-of-freedom driver and shaker system where the structural members, as individual units and as a whole, employ conclusions derived from unit analysis. Data recorded during the dynamic evaluation of the driver and shaker units, individually and as a system, indicate the strong points and shortcomings of design. To support the design approach taken here, four other cast horizontal drivers that use different exciter heads but the same techniques of design, which were proven successful, are also analyzed in this paper. Author

N67-26654# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HYDRAULIC EXCITER COMBINED ENVIRONMENT TESTS
Edwin J. Skolka *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 119–138 refs (See N67-26642 14-32)

Vibration and sustained acceleration were investigated by operating a 5000-lb force rated hydraulic vibration exciter on a 20-ft diameter centrifuge. Test parameters included a range of exciter table mass loads and variations of vibration and sustained acceleration levels. These parameters were evaluated for two different actuator thrust axis orientations with respect to the centrifuge rotational plane. The exciter test frequency spectrum was from 20 to 500 cps. Performance of the exciter-centrifuge system was determined by measuring exciter acceleration waveform distortion, response characteristics of the centrifuge, and exciter cross-axis acceleration effects. Test data indicated that the interaction of exciter harmonic content with resonances generated in the centrifuge system produced high levels of exciter acceleration distortion. Increases in sustained acceleration levels produced higher acceleration waveform distortion for frequencies above 150 cps. Author

N67-26656# Wyle Labs., Inc., Huntsville, Ala.
CONTROL TECHNIQUES FOR MULTI-SHAKER VIBRATION SYSTEMS
Richard A. Arone and Paul A. Brock (Sine Engineering Co., Granada Hills, Calif.) *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 147-155 (See N67-26642 14-32)

The problems associated with the control of a multi-shaker operation during sinusoidal and random vibration testing are complex because of the severe, unpredictable, and sometimes nonlinear effects of large structures under test, as well as possible differences in the individual shaker servo components. This paper discusses possible methods for performing these tests and outlines the requirements for equipment and basic operating characteristics of an automatic vibration control system used for an eight-shaker vibration test program. Author

N67-26673# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
DRAG PLATE BALANCE
J. A. Hunt and J. D. Horn Dec. 1966 31 p refs
(ECOM-5098; AD-648151) CFSTI: HC $3.00/MF $0.65

The paper discusses the design features of a proposed drag plate for the ASO low speed wind tunnel at White Sands Missile Range, New Mexico. The device will measure the chord force exerted on an object mounted flush atop the drag plate by the use of an external strain gage balance. The required readout system for the drag plate is given. Author (TAB)

N67-26813# Harvard Coll. Observatory, Cambridge, Mass.
SHOCK TUBE SPECTROSCOPY LABORATORY ANNUAL REPORT, 1966
W. H. Parkinson and E. M. Reeves Feb. 1967 10 p refs
(Contract Nonr-1866(48))
(AD-648392) CFSTI: HC $3.00/MF $0.65

Experimental and theoretical research in spectroscopy continued in the shock tube laboratory with emphasis on the identification and position of atomic and molecular features, the strengths and intensities of discrete autoionizing and continuous transitions and on the study of line profiles and processes which influence the positions and widths of lines. Oscillator strengths were measured by standard photographic photometry and by a new hook technique with the Mach-Zehnder and Littrow spectrograph combination. In addition, the scanning Fabry-Perot interferometer was used to measure line profiles and to study Van der Waal broadening. Author (TAB)

N67-26820# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
SUBSONIC WIND TUNNEL TESTS OF A .125 SCALE MODEL OF THE OV-10A AIRPLANE (ECP MODEL)
D. L. Millikan Aug. 1966 225 p Prepared for North Am. Aviation, Inc.
(CAL-AA-2313-W-1, Vol. III; AD-647496) CFSTI: HC $3.00/MF $0.65

The report consists of test results presented in graphical form. TAB

N67-26837# Argonne National Lab., Ill.
ENERGY-ANALYZING SYSTEM FOR THE ARGONNE 60-INCH CYCLOTRON
W. J. Ramler, J. J. Livingood, G. W. Parker, J. Aron, and M. C. Oselka Oct. 1966 58 p refs
(Contract W-31-109-ENG-38)
(ANL-7251) CFSTI: HC $3.00/MF $0.65

The extracted beam of ions from Argonne's 60-in. cyclotron, installed in 1952, has a total energy spread of about 1%. Increased sophistication of experiments within recent years has called for an analyzing system capable of reducing the spread to the lowest feasible value. The system of magnets, ancillary hardware, and the resulting dispersive and achromatic operation are discussed. An energy resolution (full width at half maximum, FWHM) of $\Delta E/E = 0.08\%$ was obtained for alphas of 43.2 MeV. Author (NSA)

N67-27052# Argonne National Lab., Ill.
BUBBLE CHAMBERS, 1964–1966
M. Derrick Oct. 1966 49 p refs Presented at Intern. Conf. on Instrumentation for High Energy Phys., Stanford, Calif., 10 Sep. 1966
(Contract W-31-109-ENG-38)
(ANL-7265; CONF-660918-17) CFSTI: HC $3.00/MF $0.65

The developments in bubble chamber technology from 1964 to 1966 are reviewed. Topics included are new conventional chambers, picture production, high-field chambers, high-field or giant chambers, large bubble chamber projects, camera location, illumination and photography, and use of neon–hydrogen mixtures. NSA

N67-27182# Structural Electric Products Corp., Windsor Locks, Conn.
DEVELOPMENT OF 60 WATT WIDE ANGLE TAXIWAY LIGHT FOR SHORT RADIUS TAXIWAY TURNS Final Report
Douglas C. Glazier, Sr. Dec. 1966 36 p
(Contract FA-65-WA-1295)
(RD-66-78)

A design and development program was conducted to produce a 60 watt wide angle taxiway light for use in airports along the center line of taxiway turns. The light is bi-directional and projects a light pattern of 100 candela over a 60° horizontal spread and 0° to 10° vertical spread. The light is in-set in the taxiway and has a maximum rise of 3/8 inches above the pavement level with a conical slope of 8° maximum. The two parts of the light are the base and optical housing. The base is permanently installed in the runway with a suitable adhesive. The optical housing is a sealed capsule that houses the lens, lamp, and by-pass device and can be easily removed from the base for maintenance or service. Photometric tests indicate this light unit will improve visual guidance for aircraft taxiing on short radius turns. Author

N67-27196# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Institut fur Angewandte Gasdynamik.
CALCULATION OF THE AERODYNAMIC CAPACITIES OF THE DVL SUPERSIONIC WIND TUNNELS AT PORZ WAHN [BERECHNUNG DER AERODYNAMISCHEN LEISTUNGEN DER UBERSCHALLWINDKANALE DER DVL IN PORZ WAHN]
G. Schulz and W. Neuberger Feb. 1967 88 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-14; DVL-597) CFSTI: HC $3.00/MF $0.65

Calculations for dimensioning of the DVL supersonic equipment are treated. The necessary basic equations and measurement results are compiled or, respectively, older fundamentals are extended and improved. Accordingly, the dimensions and capacities of the following individual tunnels are dealt with: air supply installation, supersonic wind tunnel 60×60 cm^2, supersonic wind tunnel 30×30 cm^2, free jet supersonic wind tunnel, and blowing into vacuum storage tanks. Special emphasis is placed on the 60×60 cm^2 wind tunnel. Author

N67-27222*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EFFECTIVENESS OF ENVIRONMENT-SIMULATION TESTING FOR SPACECRAFT
John C. Neu and A. R. Timmins Washington, NASA, Jun. 1967 13 p refs
(NASA-TN-D-4009) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The philosophy and purpose of ground simulation tests for unmanned spacecraft, as used at the Goddard Space Flight Center, is reviewed. Laboratory test results are presented from 16 prototype and 48 flight spacecraft. The summarized results show a four-to-one ratio in problems per spacecraft for prototype compared to flight models, and for both models the simulated space test has revealed the largest number of problems. A comparison of the number of space problems with test problems on the same spacecraft shows no correlation and shows that 100% trouble-free operation was not obtained on any spacecraft. Data from simulated space testing of 270 experiments for an observatory program show an exponential relationship of malfunctions with time. The curve can be used to estimate the number of problems that will be detected by varying the test time, but cannot be extrapolated to long-term (days) testing. The data from the systems test of a complete observatory under simulated space conditions show failures occurring after 12 days of testing and verify the need for long-term systems tests. Author

N67-27433*# Lockheed Missiles and Space Co., Huntsville, Ala.
PRELIMINARY DESIGN STUDY OF A LUNAR GRAVITY SIMULATOR Summary Report, 15 Jun.–14 Oct. 1966
R. B. Wysor Mar. 1967 26 p refs
(Contract NAS8-20351)
(NASA-CR-84439; LMSC/HREC-A783968) CSCL 14B

A preliminary design study was conducted of a Lunar Gravity Simulator (LGS) system for evaluating Lunar Surface Vehicles (LSV's). The four-month study investigated two- and

three-dimensional LGS configurations. The two-dimensional (2-D) configuration restricted LSV longitudinal axis motion to the X–Z plane while the vehicle traverses a simulated lunar terrain. The three-dimensional (3-D) configuration allowed additional LSV yaw and lateral degrees of freedom. As a result of this study, 2-D and 3-D LGS system configurations were developed which utilize currently available servo control and drive system components. Dynamic errors of the LGS system were evaluated with an analog computer by developing mathematical models of the LGS/LSV system and conducting simulated obstacle negotiation at maximum vehicle velocity and variable obstacle heights. Results indicate that the lunar gravity error may be minimized by maintaining suspension cable lengths in a 30 to 53 foot range. Cost and schedule data were developed for the design, manufacture, assembly and checkout of the functional elements (excluding building facility, etc.) of the 2-D or 3-D system. The 3-D configuration was favored over the 2-D configuration because of simulation superiority and is recommended for further design and development efforts. Author

N67-27440*# Neotec Corp., Rockville, Md.
PEGASUS DETECTOR SYSTEM EVALUATION TOOL Final Report
9 Mar. 1967 100 p
(Contract NAS8-20647)
(NASA-CR-84431; CR-3.1) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The design and fabrication of a test tool to simulate critical portions of the Pegasus detector electronics are reported. This device is to be used in determining anomalies which take the form of multiple panel identifications for one registered "hit". Included are the calibration and repair procedures for two "plasma simulators", and construction of cables and a display device to enable operation of the Pegasus earth aspect system. C.T.C.

N67-27480# Naval Radiological Defense Lab., San Francisco, Calif.
THE OPTIMIZATION OF THE CENTRAL REGION ELECTRIC FIELD FOR THE NRDL CYCLOTRON
Martin P. Reiser 28 Dec. 1966 41 p refs
(USNRDL-TR-67-5; AD-648418) CFSTI: HC $3.00/MF $0.65

Results of studies of the central region accelerating system employing the UCLA type 'dees-in-the-valleys' are presented. It is shown that a 90 deg. dee tip in conjunction with an adjustable puller best satisfies the requirements of a variable energy, multi-particle, isochronous cyclotron. The results of computer calculation for programmed orbits show that this geometry yields good orbit centering and satisfactory radial beam quality. The base width of the acceptable ion beam in the first harmonic mode is about 60 deg. at the start and broadens to 90 deg. during subsequent acceleration. In the third harmonic mode, on the other hand, the phase width is 30 deg. initially and subsequently contracts to 25 deg. Orbit details, positions of the source, puller, and defining slits are also described. Author (TAB)

N67-27482# Brookhaven National Lab., Upton, N. Y.
ECONOMICAL POWERING OF A LARGE MULTIPLICITY OF SPUTTER-ION PUMPS
T. Carides and J. G. Cottingham 28 Feb. 1967 5 p Presented at Natl. Particle Accelerator Conf., Washington, D. C.
(Contract AT(30-2)-GEN-16)
(BNL-11041; CONF-670307-1) CFSTI: HC $3.00/MF $0.65

The economic and technological aspects of separating the starting and holding power supply equipment for a large number (280 for AGS) of sputter-ion pumps used with accelerators are discussed. NSA

N67-27488# Brookhaven National Lab., Upton, N. Y.
FOLDED FERRITE LOADED CAVITIES FOR IMPEDANCE MATCHING IN THE AGS
M. Plotkin [1967] 5 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C.
(Contract AT(30-2)-GEN-16)
(BNL-11076; CONF-670307-5) CFSTI: HC $3.00/MF $0.65

The AGS conversion requires twice the accelerating volts/turn and driving amplifiers removed from the ring to a central building. The accelerating cavities must be tuned over a frequency range of 2.5 to 4.5 MHz. In addition the number of accelerating positions will be reduced from twelve to eight. These specifications combine to place severe restrictions on the accelerating cavity structure. To minimize power losses in the cavity it is necessary that more ferrite be added. A method of folding the cavities in the radial direction yields a structure which not only raises the cavity impedance, but also enables matching to the input line without using a broad band transformer. A further desirable feature of the structure is the ability to place four gaps, rather than two, in each accelerating straight section thus halving the voltage per gap and halving the voltage on the input lines. A sample computation was made using currently available ferrite in sizes essentially the same as have been used at the AGS and PPA. The results look favorable and additional ferrites are being investigated to find higher μQf values. Author (NSA)

N67-27494# Ion Physics Corp., Burlington, Mass.
ELECTRON BEAM MAPPING STUDIES ON THE 4 Mv FACILITY
S. E. Graybill and S. V. Nablo Feb. 1967 44 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SC-CR-66-158) CFSTI: HC $3.00/MF $0.65

A brief description of the IPC four megavolt pulsed electron accelerator (FX-1) is presented. Techniques which were developed for the study of the self-focused relativistic stream from the system are reviewed along with a description of the fixed field magnetic spectrometer used in the determination of the beam spectral characteristics at the entrance plane. The use of these diagnostic techniques in the mapping of streams from FX-1 at terminal potentials of 1.55 to 3.45 MV. is then described. Current density profiles and spectral data for varying stream conditions are presented under the following range of beam parameters: $0.88 \leq E \leq 2.20$ MeV and $8600 \leq I \leq 23,000$ amperes. A discussion of these results follows and their reproducibility, for the purpose of further applications, is discussed. Author (NSA)

N67-27495# Stanford Univ., Calif. Stanford Linear Accelerator Center.
DESIGN OF LOW-BETA INSERTIONS FOR STORAGE RINGS
P. L. Morton and J. R. Rees Dec. 1966 5 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C.
(Contract AT(04-3)-400)
(SLAC-PUB-246; CONF-670307-4) CFSTI: HC $3.00/MF $0.65

A design technique is presented which separates the problem of producing a small beam size at the interaction region from that of not disturbing the equilibrium orbits of off-momentum particles outside the insertion. It may be used to produce desired values of β_x and β_y in the middle of the insertion where $\eta = 0$. The same technique is applicable to the design of synchrotron sections with specially chosen beam properties. Author (NSA)

N67-27533*# International Information, Inc., Philadelphia, Pa.
BEYOND THE DOOR IS AN UNKNOWN PLANET [ZA DVER'YU–NEZNAKOMAYA PLANETA]

L. Repin May 1967 4 p Transl. into ENGLISH from Komosomol'skaya Pravda (USSR), 21 Jan. 1967
(Contract NASw-1499)
(NASA-TT-F-11062) CFSTI: HC $3.00/MF $0.65 CSCL 14B

This article discusses a special device capable of reproducing the environmental conditions of other planets. This planetary stimulator, called "Photostat-1" is essentially a pressure chamber capable of modeling the atmospheric composition, pressure, and the daily variations of Mars and other planets. This facility is the first which is capable of stimulating the UV radiation on other planets. Special lighting fixtures can imitate the entire solar spectrum, including a wide range of UV rays and individual lines of the solar spectrum. Experiments with the "Photostat" indicate that various living creatures may be able to survive in a wide range of alien conditions. Author

N67-27587# Argonne National Lab., Ill.
CONSTRUCTION OF A GLOVEBOX THERMOGRAVIMETRIC ANALYSIS APPARATUS; LANGMUIR AND KNUDSEN EXPERIMENTS ON THE EVAPORATION OF Gd_2O_3 FROM 2140 TO 2600°K Preliminary Report
Donald R. Messier Nov. 1966 20 p refs
(Contract W-31-109-ENG-38)
(ANL-7229) CFSTI: HC $3.00/MF $0.65

An apparatus for high-temperature thermogravimetric analysis, consisting of a resistance furnace and recording microbalance, was constructed in a glovebox for eventual work with plutonium ceramics. The system was tested in vacuo for leaks, furnace control, and pyrometer calibration at furnace temperatures up to 2673°K. Langmuir and Knudsen evaporation experiments were made with gadolinium sesquioxide in the temperature range from 2140 to 2600°K. Two sets of data obtained with the Knudsen cell yielded an average value of $\Delta H^0 = 464.0 \pm 1.0$ kcal/mole for the assumed evaporation reaction $Gd_2O_3(s) = 2GdO(g) + O(g)$. Enthalpy calculations based on the second and third laws of thermodynamics resulted in good agreement. The experimental results indicate that the evaporation coefficient may be much less than one. Author (NSA)

N67-27597# California Univ., Berkeley. Lawrence Radiation Lab.
BEVATRON OPERATION AND DEVELOPMENT 51, JULY–SEPTEMBER 1966
Robert W. Allison and Kenneth C. Crebbin 1 Dec. 1966 44 p refs
(Contract W-7405-ENG-48)
(UCRL-17224) CFSTI: HC $3.00/MF $0.65

The beam was on for experimenters 89% of the scheduled operating time. During this quarter, the Bevatron accelerated 2.26×10^{18} protons. The craneway and building frame were installed this quarter for a new external-proton-beam experimental hall. Four different modes of magnet pulsing were used this quarter including the new "mezzanine" mode of operation. There were two scheduled shutdowns, primarily for routine inspection of the main motor-generator journals and bearings. A vacuum gasket on a Bevatron vacuum-tank port that had been damaged by radiation was replaced and the vacuum port redesigned to minimize future damage to the gasket. Initial tests were conducted on computer control of the Bevatron inflector system. Author (NSA)

N67-27598# Stanford Univ., Calif. Linear Accelerator Center.
TWO-MILE ACCELERATOR PROJECT Quarterly Status Report, 1 Apr.–30 Jun. 1966
Sep. 1966 93 p refs
(Contracts AT(04-3)-515; AT(04-3)-400)
(SLAC-69) CFSTI: HC $3.00/MF $0.65

Progress on the two-mile Stanford linear accelerator project is reported for the period April 1, 1966 to June 30, 1966. Topics include plant engineering, systems engineering, accelerator physics, instrumentation and control, heavy electronics, mechanical design and fabrication, klystron studies, accelerator operations, beam switchyard, research area operations, and pre-operation research and development. NSA

N67-27599# Los Alamos Scientific Lab., N. Mex.
MEDIUM-ENERGY PHYSICS PROGRAM Quarterly Status Report, Jan. 31, 1967
6 Mar. 1967 56 p refs
(Contract W-7405-ENG-36)
(LA-3674-MS) CFSTI: HC $3.00/MF $0.65

The status of developments in accelerator structures, of power sources, accelerator control and instrumentation, accelerator physics, and project scheduling and facilities planning for the period ending Jan. 31, 1967 is discussed. NSA

N67-27621*# Wyle Labs., Inc., Huntsville, Ala. Research Staff.
DESIGN DETAILS FOR HELIUM HEATER
R. C. Potter 18 Nov. 1966 20 p refs
(Contract NAS8-11312)
(NASA-CR-84458; TM-66-39) CFSTI: HC $3.00/MC $0.65 CSCL 14B

Design calculations for a helium heater evaluated the following requirements: static pressures at static tappings on helium nozzle, positioning of total head probes in rake, and the use of the helium nozzle to flow air. It was recommended that the helium Mach 3.6 nozzle be used with hot air flow to check instruments; a reservoir pressure of 554 psi needed for complete expansion to atmospheric pressure produces an exit Mach number of 3.02. A clean shock free flow should be created because of the gradual change in the cross-sectional area of the helium nozzle. G.G.

N67-27623 United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
A VERSATILE PROGRAMMED FRACTION COLLECTOR
B. A. Loveridge, J. D. Wilson, and R. Hallett Dec. 1966 26 p Reprinted
(AERE-R-4766) HMSO: 4s

A fraction collector is described which will accept beakers up to 250 ml in any combination of sizes. The volume of eluate to be collected in each beaker is programmed in advance and controlled either by drop-counting or by elapsed time. The maximum instrumental resolution is nearly 0.2% of the total volume to be collected, but the precision of any one fraction is about twice this figure due to variations in drop volume with ambient temperature. Fractions of varying or constant volume may also be collected in test tubes. Author

N67-27693# Polish Academy of Sciences, Warsaw.
CHOICE OF PARAMETERS OF THE FOCUSING CHANNEL FOR THE PROTON LINEAR ACCELERATOR 10 MeV IN SWIERK [WYBOR PARAMETROW UKLADU OGNISKU-JACEGO AKCELERATORA LINIOWEGO PROTONOW 10 MeV W SWIERKU]
B. Cypa 1966 54 p refs In POLISH; ENGLISH summary
(INR-750/SLBAL/PL)

The general parameters of the focusing system of the 10 MeV proton linear accelerator in Swierk are determined. The optimum value of Ccs $\mu = 0.45$ is found for the length of focusing period equal to 4 periods of acceleration. The tolerances of the parameters of the focusing system are determined. The calculated values of acceptance and emittance are 100 and 28.5 mrad.mm respectively. Author

N67-27697# Polish Academy of Sciences, Warsaw.
THE PNEUMATIC SYSTEM FOR SHORT ACTIVATIONS [POCZTA PNEUMATYCZNA KROTKICH AKTYWACJI]

R. Post, E. Dziakowski, and T. Matysiak Oct. 1966 32 p In POLISH; ENGLISH summary
(INR-757/XI/R)

The pneumatic system for short irradiations, working under vacuum of about 1100 mm H_2O, joins the 45 mm diameter vertical channel of research reactor EWA with the spectrometry laboratory and with the station for short activations. Thermal neutron flux of 9.6×10^{12} n/cm^2 sec is accessible in the channel. The channel is cooled from outside with water of the primary circuit. Plastic containers are transported from the reactor to the spectrometry laboratory on a 21 m route in 3 seconds, and to the station for short activations on a 53 m route in 7 seconds. Shielding of both end stations allows the total activity of the containers to be not more than 100 mC (Co^{60}). Author

N67-27745*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSN CAPABILITIES AND FACILITIES
In its Space Programs Sum. 37-44, Vol. VI 31 Mar. 1967 p 17-18 (See N67-27741 14-30)

The main elements of the deep space network are briefly described. The instrumentation facility, composed of tracking and data acquisition stations over the world, is reviewed. It is pointed out that the ground communication system uses voice, teletype, and high speed data circuits between each overseas station, the Cape Kennedy station, and the Space Flight Operations Facility. The facility's instrumentation for spacecraft command, and data processing and analysis is mentioned. N.E.N.

N67-27746*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSIF DEVELOPMENT AND OPERATIONS
In its Space Programs Sum. 37-44, Vol. VI 31 Mar. 1967 p 19-23 (See N67-27741 14-30)

The flight project support, the deep space station (DSS) equipment installation and testing, and the communications development and testing are described. The Surveyor, lunar orbiter, Pioneer, and Apollo projects under consideration are covered. Installation of generators for the Pioneer DSS, paraboloid antenna for the Echo DSS, and S-band system for the Mars DSS are reported. The functions of the star clock for antenna calibrations are outlined. A step-recovery diode x6 frequency multiplier was developed for the frequency synthesizer section of the Mariner Venus 67 precision ranging system. Design details are given for a 100-kHz square-law detector and a 10.1-MHz balanced mixer, also for the Mariner precision ranging system. Initial preparations for a traveling wave ruby maser are mentioned. N.E.N.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N67-28496# Air Vehicle Corp., La Jolla, Calif.
INVISCID-INCOMPRESSIBLE-FLOW THEORY OF NORMAL AND SLIGHTLY OBLIQUE IMPINGEMENT OF A STATIC ROUND JET ON THE GROUND
T. Strand Feb. 1967 40 p refs
(Contract DA-31-124-ARO(D)-311)
(Rept.-35; AROD-5274-3; AD-648500) CFSTI: HC $3.00/MF $0.65

An inviscid-incompressible-flow theory of normal and slightly oblique impingement of a static round jet on the ground is developed and compared with the results of a bench test. The velocity distribution along the ground and across the jet exit, the location of the free stream tube boundary, and thrust ratios at constant power and constant total head are presented as functions of the height of the jet exit above the ground and of the angle of tilt. Author (TAB)

N67-28639# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
UNIQUE DETERMINATION OF EDDY CURRENT FLOW PATTERNS FROM MEASUREMENTS OF EXTERNAL FIELDS
M. J. Churchill Feb. 1967 9 p refs
(Contract AT(45-1)-1830)
(BNWL-364) CFSTI: HC $3.00/MF $0.65

A method is described for predicting current patterns in a sample by impressing an electromagnetic field on the sample and measuring the resulting fields at the surface. NSA

N67-28552*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL HEAT-TRANSFER INVESTIGATION OF NONWETTING, CONDENSING MERCURY FLOW IN HORIZONTAL, SODIUM-POTASSIUM-COOLED TUBES
Roy A. Lottig, Richard W. Vernon, William D. Kenney Washington, NASA, May 1967 28 p refs
(NASA-TN-D-3998) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Local heat transfer and static pressure data were obtained for mercury condensing inside horizontal tubes cooled by sodium potassium (NaK). Test section 1 had a constant mercury tube inside diameter of 0.37 inch. The inside diameter of the mercury tube of test section 2 decreased from 0.46 to 0.20 inch over a length of 40 inches. The mercury flow rate was varied from 126 to 190 pounds per hour. The coolant flow rate was varied from 376 to 726 pounds per hour. The condensing length ranged from 9 to 42 inches. The values of the overall condensing heat transfer coefficient varied with condensing length from 1650 to 3420 Btu/(hr)(sq ft)(°F) for a constant axial mercury temperature profile. Overall coefficients that were independent of condensing length were obtained for varying mercury temperature profiles; the averages of these coefficients ranged from 2920 to 3200 Btu/(hr)(sq ft)(°F). The mercury condensing heat transfer coefficient was concluded to be significantly larger than the NaK film heat transfer coefficient for test section 2; therefore, the NaK film heat transfer coefficient limited the rate of heat transfer to a greater extent than the mercury condensing coefficient. Author

N67-28553*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF COMBINED BUOYANCY AND SHEAR ON WEAK HOMOGENEOUS TURBULENCE
Robert G. Deissler Washington, NASA, May 1967 29 p refs
(NASA-TN-D-3999) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Two-point correlation equations, which contain mean velocity and temperature gradients as well as body force terms, are constructed from the Navier-Stokes, energy, and continuity equations. The ratio of buoyancy to shear effects, as given by the Richardson number, is a consideration. The velocity and temperature gradients, as well as the body force, are considered to be vertical and uniform. An initial value problem in which the turbulence is initially isotropic is solved to illustrate the effect of buoyancy and shear parameters on the turbulence. The initially isotropic turbulence quickly becomes anisotropic under the influence of the buoyancy and shear. Although the turbulence is assumed to be weak enough for terms in the equations containing triple correlations to be negligible, a term proportional to the velocity gradient transfers energy between wave numbers. Various components of the mean turbulent fluctuations and their spectra, as well as the ratio of eddy conductivity to eddy viscosity, are calculated as functions of buoyance and shear parameters. For highly stabilizing conditions, the interaction of the shear and buoyancy forces with the turbulence can produce negative eddy conductivities and viscosities. The analytical results are compared with available experimental data. Author

N67-26565* Scientific Translation Service, La Canada, Calif.
ON THE STRUCTURE OF SHOCK WAVES [K STRUKTURE UDARNYKH VOLN]
K. Khandrikh Washington, NASA, Feb. 1967 8 p Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), v. 21, no. 5, 1966 p 81–87
(Contract NASw-1496)
(NASA-TT-F-10623) CFSTI: $3.00 CSCL 20D

The structure of shock waves in a gas with thermal conductivity and viscosity is investigated. The "law of conservation of irreversible energy flux" within the shock front is derived. Approximate analytical expressions are obtained for the integral curve in the case when the Prandtl $P<<1$* and $P<<1$; they are also obtained for the velocity profile in a plasma with the same electron and ion temperature in the $P=0$ approximation. Author

N67-26584*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SMALL AMPLITUDE LATERAL SLOSHING IN A CYLINDRICAL TANK WITH A HEMISPHERICAL BOTTOM UNDER LOW GRAVITATIONAL CONDITIONS Summary Report
P. Concus, G. E. Crane, and H. M. Satterlee 20 Jan. 1967 128 p refs
(Contract NAS3-7119)
(NASA-CR-54700; LMSC/A852007) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A finite difference technique utilizing an irregular triangular mesh and the Wielandt inverse iteration method has been used to compute normal mode lateral sloshing in a cylindrical tank with a hemispherical bottom under reduced but still positive gravitational conditions for a contact angle of five degrees. Results of these computations have been used to calculate, using a Fourier series expansion, the liquid response to sinusoidal, square wave and periodic-pulse lateral perturbing accelerations. Reduction of liquid volume, gravity level, and contact angle reduce the fundamental (most important) lateral sloshing frequency. Author

N67-26744# California Univ., Berkeley. Div. of Aeronautical Sciences.
SUPERSONIC FLOW SEPARATION ON A BACKWARD FACING STEP
Abdallah Sfeir Dec. 1966 43 p refs
(Grant AF-AFOSR-268-66)
(AS-66-18; AFOSR-67-0656; AD-647958) CFSTI: HC $3.00/MF $0.65

The paper describes an experimental survey of flow separation on backward facing steps having different heights at a Mach number of 2.4. Reattachment and critical points are found for three regimes, laminar, transitional, and turbulent. Reattachment occurs at a point where the pressure is 35% of the free stream value for turbulent flow, and 60% of this value in the laminar case. The length of the free shear layer is found to be one-half that of the separating streamline, a result which emphasizes the importance of the reattachment region. The flow downstream of the critical point is found to be relatively independent of the base flow. Disturbances in the spanwise direction are always observed in laminar flow but do not affect the base pressure. Author (TAB)

N67-26916# Ballistic Research Labs., Aberdeen Proving Ground, Md.
PARAMETRIC REPRESENTATIONS OF NON-STEADY ONE DIMENSIONAL FLOWS: A CORRECTION
T. H. Giese Jan. 1967 29 p refs
(BRL-1352; AD-648644) CFSTI: HC $3.00/MF $0.65

BRL Report No. 1316 (AD-635 254) contains a serious logical error. This invalidates that Reports assertions about the ease with which examples of 1-dimensional flows can be constructed. The present Report (i) expurgates BRL Report No. 1316; (ii) describes the error; (iii) corrects it; and (iv) salvages a family of examples of 1-dimensional flows. Author (TAB)

N67-26950# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
ROTATIONAL TEMPERATURE MEASUREMENT OF THE FLOW EXPANDING FROM A LOW DENSITY SONIC ORIFICE
Michiru Yasuhara Aug. 1966 35 p refs
(Grant AF-AFOSR-697-66)
(USCAE-103; AFOSR-67-0335; AD-648879) CFSTI: HC $3.00/MF $0.65

Preliminary experiments of rotational temperature measurements in the nitrogen flow field of a low density free jet from a sonic orifice are made, using electron beam fluorescence with a spectrograph. In the first case of the pressure ratio of 1000/1, the measured rotational temperature appears to include the transition region from a continuum to a frozen temperature, and in the second case of the ratio of 5000/15 it appears to include both the continuum-frozen transition and the shock transition region. Author (TAB)

N67-26959# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Fluid Dynamics Facilities Research Lab.
BOUNDARY LAYER PROFILE MEASUREMENTS IN HYPERSONIC NOZZLES
Norman E. Scaggs Jul. 1966 50 p refs
(APL-66-0141; AD-648906) CFSTI: HC $3.00/MF $0.65

An experimental investigation made to determine the flow parameter profiles across the boundary layer on contoured, axisymmetric hypersonic nozzles is described. The pitot pressure and total temperature profiles measured across the boundary layers on nozzles of Mach number seven and twelve are shown in graphical form. The static temperature and velocity profiles, calculated with the assumption of constant static pressure across the boundary layer, are given. A correlation is shown to exist between the exponent of the velocity profile power law and the product of the ratios of wall temperature to free stream total temperature and axial distance to momentum thickness. The static temperature profiles, calculated from the measured data is compared with Croccos relationship for the static temperature in terms of the velocity profile. Author (TAB)

N67-26967# New York Univ., N. Y.
BOUNDARY LAYERS IN COMPRESSIBLE FLOWS WITH ARBITRARY INITIAL PROFILES AND ASSIGNED WALL SHEAR
Jack Werner Wright-Patterson AFB, Ohio, ARL, Oct. 1966 35 p refs
(Contract AF 33(615)-2215)
(NYU-AA-66-61; ARL-66-0207; AD-648912) CFSTI: HC $3.00/MF $0.65

The problem of determining the Mach number distribution required to maintain a specified wall shear in a boundary layer for a given initial shear profile is treated by solving the Crocco equation in the compressible case. The temperature of the free stream is assumed to be much higher than that of the wall. It is found that analytic solutions are readily obtainable if there is no discontinuity specified in the shear at the wall. To illustrate the method an initial profile typical of injection profiles was adopted and Mach number distribution found for a specified reduction in wall shear and for constant wall shear. Corresponding downstream shear profiles were computed and the similarity profile in the case of constant shear was found. Author (TAB)

N67-26968# Rensselaer Polytechnic Inst., Troy, N. Y.
A THEORETICAL STUDY OF NONEQUILIBRIUM FLOWS PAST POINTED BODIES
Z. S. Chang Wright-Patterson AFB, Ohio, ARL, Oct. 1966 117 p refs
(Contract AF 33(615)-1080)
(ARL-66-0208; AD-648913) CFSTI: HC $3.00/MF $0.65

The problems of nonequilibrium supersonic flows past a wedge and a cone with attached shock waves are analyzed by

Dorodnitsyns integral method. The gas may undergo either vibrational or chemical relaxation, and the uniform free stream need not be in equilibrium. The numerical integration of the nonlinear ordinary differential equations obtained by applying the integral method is carried out subject to a stability criterion governing the step size. From the behavior of the approximate equations far downstream, it is noted that correct asymptotic values for certain flow variables on the surface cannot be obtained. It is shown that within a region where the flow behind the attached shock wave is subsonic, the solutions are not analytic, and the expansion procedure for the flow variables is no longer valid. The results computed for the vibrationally relaxing flow past a wedge are generally in close agreement with the corresponding results of method of characteristics. If the flow behind the shock is only slightly out of equilibrium, the approximate equations may be further simplified by linearization. Author (TAB)

N67-27058# Technion Research and Development Foundation, Ltd., Haifa (Israel). Dept. of Aeronautical Engineering.

SMALL PERTURBATIONS TRANSONIC AND HYPERCRITICAL FLOWS WITH SHOCKS Annual Summary Report

Nima Geffen Aug. 1966 40 p refs

(Grant AF-EOAR-65-83)

(TAE-58; AD-647193) CFSTI: HC $3.00/MF $0.65

Aligned-fields steady flows of perfect gaseous conductors about slender bodies are formulated simultaneously for both transonic and hypercritical conditions of the free stream. The same set of equations and shock relations in similarity variables and suitably labeled coordinates describe the flow in the physical plane, which can be transformed into one linear, mixed-type equation for the stream function in the hodograph plane. The hyperbolic flow about a wedge fore-body is formulated in the hodograph plane, and two methods of solutions presented: (1) superposition of particular solutions, (2) finite difference. The numerical procedure is discussed and comparison between the two methods attempted. Author (TAB)

N67-27075# Franklin Inst., Philadelphia, Pa. Research Labs.

ON THE EIGENVALUES OF COUETTE FLOW IN A FULLY-FILLED CYLINDRICAL CONTAINER Final Report

M. M. Reddi Jan. 1967 41 p ref

(Contract DA-30-069-AMC-686(R))

(F-B2294; AD-647603) CFSTI: HC $3.00/MF $0.65

For a stationary flow in a cylindrical container of the couette type in an outer radial zone, and of zero velocity in an inner radial zone, the normal mode equations are derived. For negative wave numbers in the theta-direction, these equations are found to have a singularity. The eigenvalues are calculated by initial value methods employing the Runge-Kutta-Gill integration procedure. Values of the dependent function and their derivatives at the singularity are calculated by linear extrapolation coupled with continuity requirements. Tables of eigenvalues for various slenderness ratios of the cylinder and various radial nodes are given for theta-wave numbers of −1. Author (TAB)

N67-27185# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

SURFACE TENSION EFFECTS ON THE MOTION OF A BUBBLE AND SPIKE GENERATED BY TAYLOR INSTABILITY

N. R. Rajappa and I-dee Chang Jul. 1966 37 p refs

(Grant NSF GK-537)

(SUDAAR-286)

The effects of surface tension and curvature of the interface on the velocity of the bubble and spike during the intermediate and asymptotic phase of taylor instability are determined. The exact nonlinear equations of the problem are treated by means of an approximate method. The analysis is made by considering first the axisymmetric flow in a circular cylindrical tube and then the two-dimensional flow between parallel walls. The results in the axisymmetric case for the velocities of the bubble and spike are in close agreement with the experiments. But in the two-dimensional case, even though the qualitative features are the same, the results are different from those of the experiments, thereby indicating that the axisymmetric theory is a proper description of the motion of the bubble. From the motion of the bubble in the unsteady case, it is possible to verify the experimental finding that the transition stage between the initial and asymptotic phases of Taylor instability is of quite short duration. The consequence of including surface tension in the analysis gives indirectly an estimate of the effect of slight viscosity in the motion of the bubble. Author

N67-27186# General Electric Co., Philadelphia, Pa. Missile and Space Div.

THE FINITE DIFFERENCE SOLUTION OF MULTICOMPONENT NONEQUILIBRIUM STEADY INFLUSCID STREAMTUBE FLOWS USING A NOVEL STEPPING TECHNIQUE. PART I. ANALYSIS AND APPLICATIONS

D. McMenamin and M. O'Brien Apr. 1967 93 p refs

(Doc. -67SD241)

The governing equations for the steady influscid streamtube flow of a chemically reacting multicomponent in thermal equilibrium are formulated for finite difference solution and programmed in Fortran IV. A novel criterion for prescribing step size is introduced which enables the solution of a shifting equilibrium flow to within an acceptable margin of error. Comparisons with shock tube and shock layer electron density measurements and results from method of characteristics solutions are presented. Calculations for both sections of a converging–diverging nozzle are included. Author

N67-27194# General Electric Co., Philadelphia, Pa. Missile and Space Div.

PHASE SPACE SOLUTION OF BUOYANT JETS

A. Barcilon Mar. 1967 37 p

(R67SD8)

The solution of buoyant jets in calm stratified atmosphere is considered. The Morton model yields a set of differential equations that can be solved in a closed form in a phase space having for coordinates the integral with height of the mass flux, the mass flux, and the derivative with height of the mass flux. By using an approximate expression that relates the mass flux integral with height to a given height, we are able to transfer knowledge of the phase space solution to the physical space. Author

N67-27223*# Parametrics, Inc., Waltham, Mass.

EXPERIMENTAL DETERMINATION OF TRANSPORT PROPERTIES OF HIGH TEMPERATURE GASES

E. H. Carnevale, G. Larson, L. C. Lynnworth, C. Carey, M. Panaro et al Washington, NASA, Jun. 1967 113 p refs

(Contract NASw-1161)

(NASA-CR-789) CFSTI: $3.00 CSCL 20M

Temperature, rotational collision numbers, and vibrational relaxation times were determined from ultrasonic measurements. An ultrasonic (≈1 to 3 MHz) pulse method was used to measure sound velocity and sound absorption in argon, helium, nitrogen, oxygen and carbon dioxide in the temperature range of 300°–1300°K. Preliminary measurements in the temperature range of 7000°–17,000°K have been obtained in argon and nitrogen. All of the measurements were obtained at a pressure of one atmosphere. Vibrational relaxation times of carbon dioxide have also been determined from the sound absorption measurements from 300 to 1300°K. Rotational collision numbers were obtained as a function of temperature in oxygen and nitrogen and are in reasonable agreement with theoretical values. This agreement has established that the transport properties of nondissociated diatomic molecules can be determined from ultrasonic measurements. At elevated temperatures the effects of electrons, ions, and radiation must be considered. Author

N67-27265*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF A SUBMERGED NOZZLE ON A 1/14.2-SCALE MODEL OF THE 260-INCH SOLID ROCKET
Reino J. Salmi and James J. Pelouch, Jr. Washington, NASA, May 1967 16 p ref
(NASA-TM-X-1388) CFSTI: HC $3.00/MF $0.65 CSCL 21H

An experimental investigation of the flow characteristics about a submerged nozzle for the 260-inch solid rocket was conducted at the Lewis Research Center with a 1/14.2-scale model which used compressed air to simulate the exhaust gases. The study was concerned with induced flows and distortions that could result from the asymmetric cloverleaf-shaped grain port. The results showed that low pressures due to separated flow at the aft ends of the propellant grain lobes induced a highly turbulent circumferential flow in the annular passage formed by the submerged nozzle lip and the aft-end rocket casing. In the actual rocket, such a flow in the annular passage could rapidly erode insulation filler materials not designed for use in areas subjected both to high temperatures and velocities. The separated flow region behind the grain lobes also distorted the circumferential Mach number distribution of the flow through the nozzle. Modifying the ends of the grain lobes from a flat surface to a wedge shape slightly reduced the induced flow velocities. Tests with a simulated 34 percent regressed grain, however, indicated that the induced velocities were diminished to the point where little or no adverse effects should occur. Author

N67-27269*# Giannini Controls Corp., Malvern, Pa.
RESEARCH ON A NON-DESTRUCTIVE FLUIDIC STORAGE CONTROL DEVICE
T. D. Reader and S. K. Ho Washington, NASA, Jun. 1967 92 p refs
(Contract NAS12-43)
(NASA-CR-783) CFSTI: HC $3.00/MF $0.65 CSCL 13G

This report describes a non-destructive fluidic memory device with associated fluidic alphanumeric display, developed by Giannini Controls Corporation under contract NAS 12-43 with NASA Electronics Research Center. The device uses the surface tension of a liquid bead in an hour-glass-shaped cavity to achieve a bi-stable memory effect which does not require a continuous supply of fluid power. Thus, the storage device may be left passive for years without losing its information, yet the information may be changed at any time by means of a control signal. We have shown that this new approach to a fluidic memory can be easily mated to conventional fluidic devices, and that a useful fluidic display is also feasible. It appears that the non-destructive fluidic storage device is the forerunner to electro-fluidic transducers. Its successful development is a major contribution to the field of fluidics. Author

N67-27282*# National Aeronautics and Space Administration, Washington, D. C.
PROPAGATION OF OSCILLATIONS IN A TWO-PART SYSTEM OF A LIQUID AND ITS VAPOR. PART I [RASPROSTRANENIYE KOLEBANIY V DVUKHFAZNOY SISTEME ZHIDKOST' I YEYE PAR. I]
A. Viglin May 1967 14 p refs Transl. into ENGLISH from Zh. Tekhn. Fiz. (Leningrad), v. 8, no. 3, 1938 p 275–285
(NASA-TT-F-10943) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The propagation of high frequency oscillations within the boundaries of the wet region (liquid and vapor phase) of a two-phase system is mathematically investigated. Formulas are derived for two oscillatory processes: (1) low amplitude oscillations where the state of the substance does not cross the boundary curve of the two-phase region and (2) high amplitude oscillations where the state crosses the boundary and varies as either a two-phase or one-phase system. Emphasis is on the two-phase system remaining within the wet region, based on a modification of Einstein's kinetics of the dissociation of diatomic gas molecules. Author

N67-27363*# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.
LOW GRAVITY LIQUID SLOSHING IN AN ARBITRARY AXISYMMETRIC TANK PERFORMING TRANSLATIONAL OSCILLATIONS
Wen-Hwa Chu 20 Mar. 1967 41 p refs
(Contract NAS8-20290)
(NASA-CR-84404; TR-4) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The problem is solved by using characteristic functions. The force and moment due to lateral translation of a rigid axisymmetric tank are obtained, and a mechanical model is proposed. Author

N67-27369*# Tennessee Univ., Knoxville. Dept. of Mechanical and Aerospace Engineering.
FUNDAMENTAL STUDY IN LOW DENSITY GAS DYNAMICS Semiannual Progress Report, Nov. 1, 1966–May 1, 1967
M. W. Milligan, H. J. Wilkerson, and P. W. Cowling 5 May 1967 27 p refs
(Grant NGR-43-001-023)
(NASA-CR-84410; AE-67-023-2) CFSTI: HC $3.00/MF $0.65 CSCL 20D

This report outlines the progress on a theoretical and experimental investigation of rarefied, internal gas dynamics. An experimental facility has been constructed to permit the experimental study of rarefied gas dynamics. This report presents the experimental results which have been obtained for rarefied gas flow through annuli. Data for only one configuration are reported. A theoretical model has been developed for predicting the flow through annuli ranging from the continuum to the free molecule regimes. Author

N67-27512*# Northwestern Univ., Evanston, Ill. Dept. of Industrial Engineering and Management Sciences.
CONTROL MECHANISMS IN THE IDEA FLOW PROCESS: MODEL AND BEHAVIORAL STUDY
Jack Siegman, Norman R. Baker, and Albert H. Rubenstein Jun. 1966 36 p refs
(Grants NSG-495; NSF-G-2442)
(NASA-CR-84478) CFSTI: $3.00 CSCL 20D

A series of field studies on the generation and communication of ideas for new R and D projects has been under way for two years. In this paper, attention is focused on the formal and informal organizational control systems which affect this process. In particular, data are presented on patterns of communicating ideas between the originator and other members of the organization and patterns of submitting ideas to the laboratory's decision-makers for approval and funding. Some data are presented on latent ideas which are considered "good" by the originators but which are not communicated and/or submitted for approval to management. Author

N67-27521*# Scientific Translation Service, La Canada, Calif.
CERTAIN FEATURES OF THE MOTION OF A FLUID UNDER WEIGHTLESSNESS CONDITIONS [NEKOTORYYE OSOBENNOSTI DVIZHENIYA ZHIDKOSTI V REZHIME NEVESOMOSTI]
A. S. Povitskiy and L. Ya. Lyubin Apr. 1967 12 p refs Transl. into ENGLISH of a Paper Presented at the 17th Intern. Astronautical Congr., Intern. Astronautical Federation, Madrid, 9–15 Oct. 1966
(Contract NASw-1496)
(NASA-TT-F-10868) CSCL 20D

Study of the effect of weak forces normally suppressed by the Earth's gravitational field on the motion of a fluid under conditions of weightlessness. The processes of filling and emptying vessels and tubes under the action of capillary forces and by creating excess pressure in the containers are considered. The special

features of the motion of bubbles in a fluid and of drops suspended in air under weightlessness are described. The effect of the disappearance of gravitational convection during weightlessness on the nature of heat- and mass-exchange is discussed. Author

N67-27523*# Scientific Translation Service, La Canada, Calif.
EXPERIMENTAL STUDY OF THE EFFECT OF THE THERMODYNAMIC PROPERTIES OF A FLUID ON CAVITATION PHENOMENA [EKSPERIMENTAL'NOYE ISSLEDOVANIYE VLIYANIYA TERMODINAMICHESKIKH SVOYSTV ZHIDKOSTI NA KAVITATSIONNYYE YAVLENIYA]
N. S. Yershov, B. I. Borovskiy, and V. V. Yakimov May 1967 8 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), v. 9, no. 2, 1966 p 130–136
(Contract NASw-1496)
(NASA-TT-F-10913) CSCL 20D

Investigation of cavitation processes in water (at 290–359°K) and ethyl alcohol (at 293–332°K) in a venturi tube, for various values of the ratio between the volume of vapor formed during cavitation and the volume of passed fluid. It is found that the changes in this ratio and in the thermodynamic properties of a fluid do not affect its cavitation behavior. The cavitation behavior of a pump using alcohol is analyzed as an example of a real process. Author

N67-27536*# National Aeronautics and Space Administration, Washington, D. C.
LAMINAR BOUNDARY LAYER ON BLUNT BODIES, ALLOWING FOR VORTICITY OF THE EXTERNAL STREAM [LAMINARNYY POGRANICHNYY SLOY NA ZATUPLENNYKH TELAKH S UCHETOM ZAVIKHRENNOSTI VNESHNEGO POTOKA]
I. N. Murzinov Jun. 1967 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, MeKhan. Zhidkosti i Gaza (USSR), no. 6, 1966 p 124–129
(NASA-TT-F-11007) CFSTI: HC $3.00 CSCL 20D

A method is described for calculating the hypersonic laminar boundary layer on blunt-nose cones, allowing for external vorticity caused by the curved bow wave, for a velocity range of 3–8 km/sec and cone angles of 0–20°. The effect of the density ratio γ on the vortical interaction during flow past truncated cones is calculated for low rate of flow of a viscous gas at high Mach numbers, indicating a strong increase in vorticity of the external flow with decreasing γ, while the mean vorticity over the thickness of the boundary layer remains constant. Diagrams are given to illustrate the effect of vorticity on friction and heat exchange under conditions of equilibrium dissociation of the air. Author

N67-27539*# International Information, Inc., Philadelphia, Pa.
DIFFUSION IN A MULTIPLE COMPONENT GAS MIXTURE
R. B. Bird May 1967 8 p Transl. into ENGLISH from Kagaku Kogyo (Japan), v. 26, 1962 p 718–721
(Contract NASw-1499)
(NASA-TT-F-10925) CFSTI: HC $3.00 CSCL 20D

A discussion is given on diffusion in a multiple gas mixture. The various equations related to the topic and the physico-chemical processes which can be expressed logically by the equations are treated qualitatively. Author

N67-27572*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
A QUASI-THREE-DIMENSIONAL METHOD FOR CALCULATING BLADE SURFACE VELOCITIES FOR AN AXIAL FLOW TURBINE BLADE
Theodore Katsanis and Lois T. Dellner Washington, NASA, Jun. 1967 36 p refs
(NASA-TM-X-1394) CFSTI: HC $3.00 CSCL 01A

The aerodynamic design of turbine stator or rotor blades requires accurate determination of the velocity distribution on the blades. For axial flow turbines, a quasi-three-dimensional compressible flow analysis has been used successfully for many years. The analysis is based on two methods—one to obtain a blade-to-blade variation of velocity, and the other to obtain the radial variation in velocity. A combination of the methods gives a quasi-three-dimensional compressible flow analysis. Most of the calculations have been incorporated into a program. This report gives a description of the quasi-three-dimensional flow analysis and the FORTRAN IV computer program. Author

N67-27624# Aeronautical Research Council (Gt. Brit.)
NEAR-FROZEN QUASI-ONE-DIMENSIONAL FLOW. PART I: THE RESERVOIR PROBLEM
P. A. Blythe (Imperial Coll.) 22 Aug. 1966 40 p refs
(ARC-28248)

Non-equilibrium quasi-one-dimensional nozzle flows are considered in the limit when the relaxation time is large compared with some characteristic flow time. Non-uniformities which arise in the reservoir region, for convergent-divergent nozzles, are treated by the method of matched asymptotic expansions. It is shown that even away from this stagnation zone the solution does not proceed simply in integral powers of the rate parameter. The correct solution is deduced for a vibrationally relaxing gas. It is noted, however, that this near-frozen solution does not necessarily remain valid at downstream infinity where the overall entropy production may become important. Solutions valid in this region are presented. Author

N67-27684# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
PRESSURE-DROP CHARACTERISTICS FOR THE FLOW OF SUBCOOLED WATER AT ATMOSPHERIC PRESSURE IN NARROW HEATED CHANNELS, PART II
R. Forgan and R. H. Whittle Dec. 1966 15 p ref
(AERE-M-1739, Pt. II) HMSO: 3s

The results of pressure-drop measurements for water flowing in a heated channel of rectangular cross-section 24 in. long × 1.0 in. × 0.127 in. are reviewed. Similar measurements were carried out with channels of similar geometry but with a range of heated lengths and gap widths. A set of measurements was also made with a tubular channel having an i.d. of 0.254 in. The object of the measurements has been to determine the parameters which define the minima in the pressure-drop/flow curves (S-curves), and hence a criterion for assessing the onset of parallel-channel instability. A correlation has been derived relating the ratio $\Delta T_e/\Delta T_{sat}$ at the minima of the S-curves to the L_h/D_h of the channel. Author

N67-27702*# Wyle Labs., Inc., Huntsville, Ala.
PROGRAM TO MEASURE THE MACROSCALE TURBULENCE OF SUBSONIC JETS
E. B. Miller Nov. 1966 73 p refs
(Contract NAS8-11312)
(NASA-CR-84423; WR-66-46) CFSTI: HC $3.00 CSCL 20D

The experiments reported here are to extend the description of a turbulent shear flow beyond the normally used statistical presentation. Eight hot wires, arranged as four cross-wire pairs, were used with a high speed analog-to-digital converter and a digital data acquisition system to study the macroscale of the turbulent shear region of several small subsonic cold air jets. The apparatus, the experimental techniques, the data analysis, and presentation programs are described, and some preliminary results for presentation of the fluctuating velocity components are given. Possible techniques for calculating the instantaneous vorticity components and transverse scale of the turbulence are given in the appendices. Author

N67-27730# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE ASYMPTOTIC INTEGRATION OF THE EQUILIBRIUM EQUATIONS OF A FLUID WITH SURFACE TENSION IN A GRAVITY FIELD
L. S. Saubshchik and V. I. Iudovich [1967] 8 p refs Transl. into ENGLISH from Vychisl. Mate. i Matem. Fiz. (USSR), v. 6, no. 6, 1966 p 1127–33

A foundation is given for the boundary layer method as applied to the problem of equilibrium of a fluid enclosed in a cylindrical vessel of arbitrary cross-section, with surface tension in a gravity field. Mathematically the problem reduces to the asymptotic integration of an equation with a small parameter for a quasi-linear elliptic operator with nonlinear boundary condition. Author

N67-27737# Lockheed Missiles and Space Co., Palo Alto, Calif.
MEASUREMENT OF THE AIR TEMPERATURE BEHIND A REFLECTED SHOCK IN THE 20–30 MACH NUMBER RANGE OF THE INCIDENT SHOCK
A. A. Kon'kov, A. P. Riazin, and V. S. Rudnev [1967] 6 p refs

Results of measuring the air temperature behind a reflected shock in the 20–30 Mach number range of the incident shock are presented. Good agreement between experimental values of the temperature and those computed on the basis of conservation laws is found up to a Mach number of 23. For higher values of the Mach number, a deviation of the experimental from the computed values occurs, which is not, however, outside the limits of measurement error. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N67-26490# Weather Bureau, Silver Spring, Md. Techniques Development Lab.
ANALYSIS OF CLEAR AIR TURBULENCE DURING SELECTED 5-DAY DATA PERIODS Final Report
De Ver Colson Dec. 1966 77 p refs
(Contract FA-66-WAI-106)
(SRDS-RD-66-79; AD-648610) CFSTI: HC $3.00/MF $0.65

Clear air turbulence data were collected from two of the four world-wide reporting periods set up by the International Civil Aviation Organization (ICAO). The occurrences and non-occurrences of turbulence were summarized with respect to time periods, altitudes, and geographical locations. These data were analyzed in relation to associated meteorological parameters and large-scale synoptic patterns. Special attention was given to areas with at least 25 percent probability of moderate or greater turbulence. Vertical wind shear appeared to be an important parameter along with 12-hour changes in wind speed, vertical wind shear, and horizontal wind shear. The synoptic patterns on the mean 300-mb charts and the individual 300-mb charts were discussed in relation to the probabilities of moderate or greater turbulence. The following forecast criteria were suggested: moderate or greater turbulence will be found (1) within 150 miles of a jet stream with at least a 100-knot maximum wind speed if the vertical wind shear is at least 4 knots per 1000 feet, or (2) within 150 miles of a sharp trough line with a marked horizontal wind shear across the trough line. Author (TAB)

N67-26506*# California Inst. of Tech., Pasadena. Geological Sciences Div.
APPARATUS TO MEASURE THE MID-INFRARED SPECTRAL EMITTANCE OF COLD POWDERS IN A VACUUM
Alexander F. H. Goetz and Curtis A. Bauman [1965] 12 p refs
(Grant NsG-56)
(NASA-CR-84158) CFSTI: HC $3.00/MF $0.65 CSCL 08G

A compact apparatus enclosed in a stainless steel vacuum chamber was used to measure the 8–13μ emittance of silicate powders under simulated lunar conditions. Samples with surface temperatures as low as 180°K were measured. The sample was contained in the removable lid of a constant temperature bath and its upper surface allowed to radiate into a cavity maintained at liquid nitrogen temperature (77°K). The spectral emittance was computed by matching the observed spectrum with a Planck function at specified wavelength intervals. System response was determined with an internal calibrating blackbody maintained at 273°K. Author

N67-26571* National Aeronautics and Space Administration, Washington, D. C.
GRAVITATION AND TERRESTRIAL MAGNETISM, PART I [GRAVITATION UND ERDMAGNETISMUS]
T. Schlomka May 1967 47 p refs Transl. into ENGLISH from Beitr. Geophysik (Leipzig), v. 5, 1938 p 357–406
(NASA-TT-F-10889) CFSTI: $3.00 CSCL 08N

Conventional theories of rotation of terrestrial magnetism and gravitation are reviewed and critically compared. A mathematical formula is established for the elementary forces involved, from which it is concluded that all atoms of a sphere of matter must be polarized in radial direction, producing a magnetic field h_x upon rotation, having the same configuration as the earth's magnetic field h_e. The degree of polarization and intensity of field is predicated on the value of repulsive and attractive forces $(\beta - \alpha)$ which is calculated from the geomagnetic field as $+0.13 \times 10^{-18}$. Numerical values are given for the attractive force between electrically uncharged bodies determined from general gravitation, and for the influence of mass distribution in the earth's crust on the geomagnetic field. Author

N67-26594*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEMPERATURE, PRESSURE, DENSITY AND WIND MEASUREMENTS IN THE UPPER STRATOSPHERE AND MESOPHERE, 1965
W. S. Smith, J. S. Theon, P. C. Swartz, L. B. Katchen, and J. J. Horvath (Mich. Univ.) May 1967 97 p refs
(NASA-TM-X-55780; X-621-67-215) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Complete data are presented from a total of 43 rocket borne experiments conducted at Wallops Island, Virginia, Churchill, Manitoba, Canada, Barrow, Alaska, Ascension Island in the South Atlantic Ocean and from a ship sailing southward from the equator to 60°S latitude off the west coast of South America during 1965. Temperature, pressure, density and wind profiles from 33 grenade experiments and temperature, pressure and density profiles from 10 pitot-static tube experiments covering the altitude range of approximately 30 to 90 kilometers have been compiled. No attempt has been made to analyze the meteorological significance of these data in this report. Error analyses are included for the results of each of the 33 grenade experiments. Author

N67-26664# Pennsylvania State Univ., University Park. Mineral Industries Experiment Station.
WIND PROFILES, SPECTRA, AND CROSS-SPECTRA OVER HOMOGENEOUS TERRAIN Annual Report, 1 Jun. 1965–31 May 1966

Alfred K. Blackadar and Anton S. Chaplin Ft. Monmouth, N. J., Army Electron. Command, 30 Jun. 1966 34 p refs
(Contract DA-28-043-AMC-01388(E))
(ECOM-01388-1; AD-648444) CFSTI: HC$3.00/MF$0.65

An approximate theory of wind profiles below 200 meters is developed based on planetary boundary layer wind models by several authors. In the case of neutral stratification, the theory has been adapted for fitting observed profiles and the derivation of parameters. In the case of diabatic stratification the generalized wind profile equation can be transformed into the same form as the KEYPS equation which has been used hitherto in lower layers. A method of determining eddy exchange coefficients is applied to a composite wind distribution and preliminary values are given in tabular form. Author (TAB)

N67-26671# Wichita State Univ., Kans.
METEOR-INDUCED MICROPULSATIONS Final Report, 12 Oct. 1964–31 Oct. 1966
A. W. Jenkins, Jr. 1 Nov. 1966 63 p refs
(Contract AF 19(628)-4768)
(AFCRL-66-831; AD-648349) CFSTI: HC$3.00/MF$0.65

The production of geomagnetic micropulsations by meteors is investigated theoretically, and experimental measurements are reported which attempt to detect the meteor-induced signal. The theoretical treatment is of an ellipsoidal meteor trail having a conductivity which is enhanced over adjacent ionospheric regions and thus disturbs the normal ionospheric currents. The magnetic field perturbation at the surface of the earth is calculated from the altered current density. Amplitudes of magnetic signals as a function of meteor position and orientation relative to both observer and ionospheric current are obtained, and results indicate a maximum signal of several milligamma. Observations are reported which attempt to correlate magnetic variations recorded by induction detectors and photoelectrically observed meteors. No obvious correlation was seen in the record covering 59 sporadic meteors. However, statistical treatment of the data seems to indicate a magnetic signal on the fringe of detectability. Author (TAB)

N67-26672# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
DIFFERENCES OF TOWER AND PIBAL WIND PROFILES
L. J. Rider and M. Armendariz Nov. 1966 20 p refs
(ECOM-5095; AD-648150) CFSTI: HC$3.00/MF$0.65

The time and space variability of the wind as derived from tower-mounted anemometers and triple-theodolite pilot-balloon (pibal) observations at the same altitude at Green River, Utah, during four nighttime operations in September 1965 is analyzed. Simultaneous wind measurements from the balloon and tower-mounted anemometers at 53.4, 68.6, 91.5, 122.0, and 152.4 meters above the ground are compared. Mean differences in wind directions were 14.0 degrees except at the lowest level, where the mean difference was 17.0 degrees. Sample standard deviations of direction differences were 19, 15, 11, 10, and 10 degrees, respectively. The pibal wind speeds were approximately 1.0 meter/sec greater than the tower wind speeds at all five levels, and sample standard deviations of the wind speed differences were approximately 2.0 meters/sec. Author (TAB)

N67-26816# Air Force Communications Service, Scott AFB, Ill. Operations Research Analysis Office.
CONCEPT AND USE OF IONOSPHERIC SOUNDERS
R. L. Feik Jul. 1966 40 p
(AFCS-4-ORR-66; AD-647596) CFSTI: HC$3.00/MF$0.65

Ionospheric sounders, installed to operate over selected high frequency communications paths, have failed to provide the operational gains expected. Hq AFCS examination of this problem has clearly identified several prevalent errors that require correction. These errors severly limit productive use of the sounders. The report covers: (a) The concept and minimum procedures required for operational use of sounders by sounder and technical control personnel; (b) sufficient background data so that supervisors (Maintenance, Telecom Officers and Squadron Commanders) can properly examine their units operational use of sounders and thereby evaluate the relative competence of their subordinates in sounder maintenance, operation, analysis and use of sounder data in frequency selection. Author (TAB)

N67-26874# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
A WORLD ATLAS OF ATMOSPHERIC RADIO REFRACTIVITY
B. R. Bean, B. A. Cahoon, C. A. Samson, and G. D. Thayer Washington, GPO, 1966 138 p refs Sponsored by Navy Weather Res. Facility
(ESSA-MONO-1; AD-648805) GPO: HC$2.25; CFSTI: MF$0.65

The Atlas presents world maps and graphs of upper-air radio refractivity, N(Z) (where Z is the altitude), mean monthly ΔN (the difference between the refractivity at the surface and at 1 km above the surface), extreme values of gradients of refractivity observed in the lowest layer of the atmosphere (including maps of minimum trapped frequency ducting gradients), and monthly mean tropopause heights. All refractivity values were derived from radiosonde data. The N(Z) maps are presented in terms of a three-part exponential model, with separate exponentials for the water vapor and air density terms of N(Z), with the latter separated into tropospheric and stratospheric terms. The ΔN data were derived by interpolation from fixed pressure-level data. Author (TAB)

N67-26888# Texas Instruments, Inc., Dallas. Science Services Div.
CONTINUATION OF BASIC RESEARCH IN CRUSTAL STUDIES Annual Report
Max K. Miller, A. Frank Linville, and Hugh K. Harris 30 Jan. 1967 134 p refs
(Contract AF 49(638)-1588; ARPA Order 293)
(AFOSR-67-0519; AD-648149) CFSTI: HC$3.00/MF$0.65

A study was made of the thermal decomposition of perchlorate of ammonium (PA) at 214 to 470C by the gravimetric method in an air atmosphere. The following values of the energies of activation of the decomposition were determined: orthorhombic form, E = 40 kcal/mole; cubic form, E = 24 to 28 kcal/mole; and residue from low-temperature reaction E = 36 to 39 kcal/mole. A study was made of the influence of oxides, chlorides, carbonates, and oxalates of a number of metals on the thermal decomposition of PA. It was shown that the compounds of manganese and cobalt lead to complete decomposition of the PA at a temperature below 240C. The compounds of iron, nickel, and chromium lead to complete decomposition of PA at 270 to 280C. At the same temperature, the maximum rate of decomposition of PA with additives of the compounds of Cu, Mn, Co, as well as ZnO is greater than the maximum decomposition rate of the pure PA; the maximum decomposition rate of mixtures of PA with compounds of iron, nickel (II), chromium, as well as V_2O_5 is less than for pure PA. The activity of additives of the same element decreases in the following order: carbonate (oxalate), oxide, and chloride. Author (TAB)

N67-26909# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
NATURAL CONVECTION IN ICE MELTING FROM BELOW
Yin-Chao Yen Dec. 1966 20 p refs
(CRREL-RR-211; AD-648515) CFSTI: HC$3.00/MF$0.65

An experimental technique was successfully developed to study the effect of natural convection (thermal instability) on the melting rate of ice. Reproducible results were obtained by using homogeneous, bubble-free ice samples for the melting process. The problem of volume change due to phase transition or seperation of the ice-water interface encountered when melting from below

was solved by continuously adding water at the same temperature as the constant temperature bath which supplied the heat for melting. Under certain temperature conditions irregularities in the interface, a result of convective motion, became very apparent and could be observed visually. By periodically measuring the amount of water added and varying the initial temperature of the ice sample T sub zero and that of the heat source T sub s extensive results were obtained demonstrating the effects of these temperatures on the melting rate which could be expressed in terms of dimensionless parameters. Author (TAB)

N67-26913# Navy Electronics Lab., San Diego, Calif.
SEA-SURFACE TEMPERATURE ESTIMATION. TIME-SERIES LENGTH NECESSARY FOR LONG-TERM ESTIMATION OF SEA-SURFACE TEMPERATURE *Research Report*, Jul. 1961–Aug. 1964
E. R. Anderson and C. J. van Vliet 17 Jan. 1967 28 p refs
(NEL-1429; AD-648555) CFSTI: HC $3.00/MF $0.65

Time-series of sea-surface temperatures recorded in the North Pacific and North Atlantic over periods up to 40 years were analyzed by autocorrelation and regression techniques. It was found that record lengths of 8 to 10 years are necessary to obtain reliable long-term estimates of sea-surface temperature. The analysis also showed that year-to-year differences exist in annual average temperature and that such variability is to be expected. Author (TAB)

N67-26971# Braddock, Dunn and McDonald, Inc., El Paso, Tex.
TIME DEPENDENT NEUTRON TRANSPORT FROM A POINT ISOTROPIC SOURCE AT AN ALTITUDE OF (24,384 KM) 80,000 FT
James P. George and Albert Lavagnino 28 Jun. 1966 290 p refs
(Contract DA-49-146-XZ-532)
(DASA-1820-1; AD-647164) CFSTI: HC $3.00/MF $0.65

The results of a run of the Augeas Monte Carlo neutron transport code are presented. The neutron sources used are isotropic and monoenergetic, with source energies between 0.01 MeV and 14 MeV. The source altitude is 80 kilofeet in a reference atmosphere. A detailed rationale for locating the neutron detector is given. The neutron flux, resolved into 20 time intervals, and the neutron fluence, resolved into 16 energy intervals, is reproduced from the code output. Comprehensive total fluence curves are presented. Detailed flux vs. time and fluence vs. energy histograms are presented for the representative source energies 14 MeV and 1.4 MeV. Author (TAB)

N67-27016# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
DETERMINATION OF D-REGION TIME CONSTANTS FOR ELECTRON COOLING AND ELECTRON DENSITY PROFILES FROM PHASE OR AMPLITUDE WAVE INTERACTION MEASUREMENTS
B. E. Spielman 30 Jan. 1967 107 p refs
(Contract Nonr-656(935))
(SR-288; AD-648455) CFSTI: HC $3.00/MF $0.65

A technique was developed for determining electron density profiles in the D-region from measurements of either phase or amplitude wave interaction. The method accounts for the effects of underlying ionization and a wanted pulse of finite width, while assumptions inherent in the methods of previous workers are relaxed. Two techniques are developed for the determination of D-region time constants for cooling from either phase or amplitude wave interaction measurements. Neither technique necessitates employing a gyro-wave disturbing signal. In one method an iterative partial sum per cent error procedure is used to find the best exponential profile for the interaction measurements. This technique accounts for the effect of underlying ionization. In the other method a value of the time constant is determined for the region of dominant heating from the slope of the interaction curve at upper heights. Both of these techniques have been extended to include the effects of a wanted pulse of finite width. Author (TAB)

N67-27078# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AMPLITUDE ANOMALIES AT LASA
P. W. Broome, F. A. Klappenberger, and D. E. Frankowski 9 Jan. 1967 73 p
(Contract AF 19(628)-5167)
(LL-4; ESD-TR-67-42; AD-647260) CFSTI: HC $3.00/MF $0.65

Average amplitude anomalies are presented as functions of source region. Data from approximately 220 events were used in this analysis. Author (TAB)

N67-27089*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
GEOPHYSICAL RESEARCH
In its Res. Lab. of Electron. 15 Apr. 1967 p 49–50 refs (See N67-27081 14-23)
(Grants NGR-22-009-131; NGR-22-009-114; Contract DA-28-043-AMC-02536(E))

In geophysical research of upper atmospheric physics, optical radar and airglow observations were made under noctilucent clouds. In addition to optical radar instrumentation, a developmental airglow photometer was also mounted in an instrumentation trailer to derive simultaneous measurements of the intensity and rotational temperature of the OH emission from the mesosphere. This analysis corroborates the results obtained previously, with definite echoes observed from altitudes between 65 km and 70 km, the strongest echoes being observed when noctilucent cloud displays had been visible overhead during twilight hours. R.U.

N67-27141# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
GLACIATION OF THE URALS, NO. 16
L. S. Troitsky, V. G. Khodakov, V. I. Mikhaliov, A. S. Guskov, I. M. Lebedeva et al 1966 345 p refs In RUSSIAN; ENGLISH summary
CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. PECULIARITIES OF RELIEF AND GLACIATION MORPHOLOGY L. S. Troitsky p 10–45 (See N67-27142 14-13)
2. GENERAL ATMOSPHERIC CIRCULATION A. S. Guskov p 46–49 (See N67-27143 14-13)
3. MAJOR ELEMENTS OF CLIMATE A. S. Guskov p 49–77 (See N67-27144 14-13)
4. SYNOPTIC CONDITIONS OF CHARACTERISTICS WEATHER TYPES V. N. Adamenko p 77–91 (See N67-27145 14-20)
5. HYDROLOGICAL DESCRIPTION V. G. Khodakov p 91–101 (See N67-27146 14-13)
6. SNOW COVER FORMATION AND SNOW ACCUMULATION ON GLACIERS V. G. Khodakov p 102–140 (See N67-12747 14-13)
7. ABLATION AND METHODS OF ITS MEASUREMENT I. M. Lebedeva and V. N. Adamenko p 141–145 (See N67-27148 14-13)
8. RADIATION FACTORS OF MELTING I. M. Lebedeva, V. N. Adamenko, and L. A. Zhivkovich p 145–170 (See N67-27149 14-13)
9. TURBULENT HEAT AND MOISTURE FLOWS I. M. Lebedeva, V. N. Adamenko, and L. A. Zhivkovich p 170–180 (See N67-27150 14-13)
10. TYPES OF MELTING V. N. Adamenko p 180–182 (See N67-27151 14-13)
11. MELTING REGIME OF SNOW COVER AND GLACIERS V. G. Khodakov p 182–183 (See N67-27152 14-13)

12. REGULARITIES IN SPATIAL VARIATION OF ABLATION FROM THE SURFACE OF GLACIERS AND NEVES V. G. Khodakov p 183–194 (See N67-27153 14-13)

13. METHODS OF CALCULATION OF SNOW, FIRN AND ICE MELTING I. M. Lebedeva and V. G. Khodakov p 194–196 (See N67-27154 14-13)

14. TOTAL ABLATION OF GLACIERS SURFACE V. G. Khodakov p 196–199 (See N67-27155 14-13)

15. RUN-OFF FROM GLACIERS L. A. Zhivkovich p 199–208 (See N67-27156 14-13)

16. TEMPERATURE REGIME OF GLACIERS V. I. Mikhaliov p 209–220 (See N67-27157 14-13)

17. PROCESSES OF ICE FORMATION AND GLACIER CONSTRUCTION V. I. Mikhaliov p 221–238 (See N67-27158 14-13)

18. MATTER BALANCE OF GLACIERS V. G. Khodakov p 239–256 (See N67-27159 14-13)

19. HISTORY OF GLACIATION OF THE URALS L. S. Troitsky p 257–282 (See N67-27160 14-13)

N67-27142# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

PECULIARITIES OF RELIEF AND GLACIATION MORPHOLOGY

L. S. Troitsky *In its* Glaciation of the Urals, No. 16 1966 p 10–45 (See N67-27141 14-13)

This survey covers major features of relief of all 143 glaciers existing as of June 1964 in the western and eastern part of the Polar Urals. Two types of glaciers are found in this region, namely slope glaciers and corrie glaciers. The largest of these relatively small glaciers are approximately 1.2 km^2 in area and have a maximum thickness of slightly more than 100 m. All of the glaciers are located below the zone of perennial ice. The climatic conditions affecting the distribution of the glaciers are discussed. Glaciation morphology and relief-forming activities are covered. Tables and charts are presented which reflect location, exposure, altitude, dimensions, and structure of the glaciers. Transl. by K.W.

N67-27143# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

GENERAL ATMOSPHERIC CIRCULATION

A. S. Guskov *In its* Glaciation of the Urals, No. 16 1966 p 46–49 (See N67-27141 14-13)

The role of atmospheric circulation in determining the hydrometeorological characteristics of the glacier regions in the Polar Urals is summarized. The climate of the northern Urals is affected by arctic winds originating in the central Polar basin and by winds from temperate latitudes. Included in the discussion are seasonal variations of frontal movements, effects of continental warm air currents from central Asia and from the European part of the U.S.S.R., winds originating over the Atlantic Ocean, and the contribution of cyclones. Transl. by K.W.

N67-27144# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

MAJOR ELEMENTS OF CLIMATE

A. S. Guskov *In its* Glaciation of the Urals, No. 16 1966 p 49–77 (See N67-27141 14-13)

The climatological zones of the northern Polar Urals region and of the mountainous part of the northern Urals are defined. The radiation regimes are discussed, and the radiation balance is derived. Air pressure and wind velocity measurements were made. Prevailing winds throughout the year are shown by month in form of wind roses for four stations. Air temperature and humidity data of the region are given. Frequency of fog formation, frequency and amount of precipitation, and perennial climatic changes are discussed. Transl. by K.W.

N67-27146# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

HYDROLOGICAL DESCRIPTION

V. G. Khodakov *In its* Glaciation of the Urals, No. 16 1966 p 91–101 (See N67-27141 14-13)

A discussion of the hydrographic characteristics of the Polar Urals region includes direction and flow capacity of rivers; distribution, altitude, and size of lakes; location and size of swamps; and ice formation on lakes and rivers. The water regime of the experimental basin of the river Bolshaya Khadata is studied from data obtained at the glaciological station at the basin. The basin covers an area of 132 km^2 and is located at an elevation of 580 m. Daily, monthly, and annual data of precipitation, run-off, evaporation, and air temperature are presented. The annual run-off of the rivers in the region of the northern Urals is analyzed. Transl. by K.W.

N67-27147# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

SNOW COVER FORMATION AND SNOW ACCUMULATION ON GLACIERS

V. G. Khodakov *In its* Glaciation of the Urals, No. 16 1966 p 102–140 (See N67-27141 14-13)

The various types of snow of the Polar Urals region are examined for layer stratification, volumetric weight, reflection characteristics, penetration by shortwave radiation, thermal conductivity, plasticity, and cohesive strength. Snow accumulation, temperatures, and changes in the stratification of the snow cover on the glaciers are determined and analyzed. Measurements and results of calculations are presented which indicate snow storage distribution and processes of redistribution. Snow-gauge measurements along the latitudinal profile across the Polar Urals show that in its western part a zone of high accumulation exists which is several tens of kilometers wide, with storages between 600 to 800 mm. In the lowlands and in the eastern part of the mountains the storage does not exceed 100 to 300 mm. Most glaciers are located in this zone. Snow accumulation on slope glaciers occurs mostly by deposition of blizzard snow removed from the plateaus, while on corrie glaciers the accumulation is mostly due to avalanches and sagging air currents over the corries during snowfall. Transl. by K.W.

N67-27148# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ABLATION AND METHODS OF ITS MEASUREMENT

I. M. Lebedeva and V. N. Adamenko *In its* Glaciation of the Urals, No. 16 1966 p 141–145 (See N67-27141 14-13)

Observations and measurements to determine the rate of melting and evaporation of the snow cover and the ice of glaciers in the Polar Urals are briefly discussed. Measured were the regimes of heat uptake and loss that make up the heat balance of the surface layers. The thicknesses of the snow and firn covers were measured regularly during the melting seasons of the six years between 1958 through 1963. Lysimetric readings were taken at various contours of the surface layers to determine the rate of water run-off. Diurnal variations in the intensity of ablation were established. Radiation intensities were measured on different surface areas of the glaciers. An equation for engineering calculations of surface ablation on glaciers is included. Transl. by K.W.

N67-27149# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

RADIATION FACTORS OF MELTING

I. M. Lebedeva, V. N. Adamenko, and L. A. Zhivkovich *In its* Glaciation of the Urals, No. 16 1966 p 145–170 (See N67-27141 14-13)

The equation for the radiation balance is stated, and the exposure of glaciers to direct and scattered solar radiation is analyzed. Diurnal variations in the total effective radiation and the

resulting melting rates during the thawing season were determined for a representative number of glaciers. The amounts of absorbed and reflected short wave radiation were measured. A semi-empirical equation is given for calculating effective radiation. Ice penetration by solar radiation is shown during clear, partly cloudy, and cloudy days. Transl. by K.W.

N67-27150# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
TURBULENT HEAT AND MOISTURE FLOWS
I. M. Lebedeva, V. N. Adamenko, and L. A. Zhivkovich *In its* Glaciation of the Urals, No. 16 1966 p 170–180 (See N67-27141 14-13)

The effects of turbulent currents of heat and moisture on heat balance and ablation of the snow cover of glaciers are studied. An equation is given for calculating the heat and moisture flows. Presented are data on density characteristics and typical profiles of temperatures and air velocities in the layer of air immediately above the surface of the glacier. The dependence of the coefficient of external diffusion on wind velocity and other factors is examined, and the heat balance structure is presented for melting seasons of glacier snow and ice. Transl. by K.W.

N67-27151# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
TYPES OF MELTING
V. N. Adamenko *In its* Glaciation of the Urals, No. 16 1966 p 180–182 (See N67-27141 14-13)

Types of weather and synoptic situations of the Polar Urals are analyzed for their effect on glacier melting. Considered are the following: (1) the radiative type, when the weather in the observed region is affected mainly by anticyclone poles; (2) the advective type, when weather is affected chiefly by cyclone poles; and (3) the advective–radiative type, when the weather is influenced both by cyclone and anticyclone poles. A graph showing chronologic fluctuations in the melting process and in the meteorological factors affecting the melting is included for a representative glacier for a period during July–August 1959. Transl. by K.W.

N67-27152# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
MELTING REGIME OF SNOW COVER AND GLACIERS
V. G. Khodakov *In its* Glaciation of the Urals, No. 16 1966 p 182–183 (See N67-27141 14-13)

A summary is presented of conditions and factors affecting the melting process of glaciers in the Polar Urals during the course of a year. There is practically no ablation between October and March. Air temperatures and radiation intensities are briefly discussed for the months of the melting season, and the peak melting periods are reported. Radiation and turbulent heat and moisture flows contribute about equally to the melting of glaciers. A close correlation exists between mean air temperature for the summer and the melting of glaciers, which regularly drops with increasing altitude of the glacier's location. Transl. by K.W.

N67-27153# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
REGULARITIES IN SPATIAL VARIATION OF ABLATION FROM THE SURFACE OF GLACIERS AND NEVES
V. G. Khodakov *In its* Glaciation of the Urals, No. 16 1966 p 183–194 (See N67-27141 14-13)

The influence of the size of a firn or glacier on the ablation intensity is analyzed. Heat transfer and water flow equations are developed for determining the turbulent regimes affecting the loss rates and for calculating the heterogeneous boundary conditions of the thermal layer above the melting surface. Characteristics of heat balance and ablation intensity are considered for the surface of corrie glaciers, followed by an example of ablation conditions as they existed at a corrie glacier during a week in July 1962. The effect of absolute altitude on the ablation of glaciers is also covered. Transl. by K.W.

N67-27154# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
METHODS OF CALCULATION OF SNOW, FIRN AND ICE MELTING
I. M. Lebedeva and V. G. Khodakov *In its* Glaciation of the Urals, No. 16 1966 p 194–196 (See N67-27141 14-13)

An improved method for obtaining minimum melting rates over short periods is presented. Radiation values and temperatures of turbulent air were derived to calculate the temperature coefficient of snow melting during 24-hour periods. The dependence of the value of the melting coefficient on temperature is demonstrated by a first approximation equation. Numerical results obtained with this method for one glacier are compared with measured values and are found to be in good agreement. Transl. by K.W.

N67-27155# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
TOTAL ABLATION OF GLACIER'S SURFACE
V. G. Khodakov *In its* Glaciation of the Urals, No. 16 1966 p 196–199 (See N67-27141 14-13)

The value of total ablation of a glacier's surface for the entire melting period of a given year is a major factor in determining the material balance of the glacier. Total ablation values of two glaciers in the Polar Urals were measured during the six years from 1958 through 1963. Measuring methods and results are briefly discussed. Transl. by K.W.

N67-27156# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
RUN-OFF FROM GLACIERS
L. A. Zhivkovich *In its* Glaciation of the Urals, No. 16 1966 p 199–208 (See N67-27141 14-13)

For studying the processes of run-off formation, the glacier Igan was chosen as being typical of the glaciers in the Polar Urals. Field measurements of flow characteristics were made during the years 1958 through 1963, and detailed hydrological and meteorological observations were conducted. Measured were heat balances, air temperatures, water balances of rivulets, total flow values, and the solid run-off of rivulets. Transl. by K.W.

N67-27157# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
TEMPERATURE REGIME OF GLACIERS
V. I. Mikhaliov *In its* Glaciation of the Urals, No. 16 1966 p 209–220 (See N67-27141 14-13)

Detailed temperature measurements were made on several corrie and slope glaciers representative of the types that are prevalent in the Polar Urals. Temperatures were measured at depths down to 25 m and in the firn and ice sections of the glaciers. Air temperatures were measured during all seasons of the year and correlated with glacier temperatures. Calculations to obtain temperature gradients and temperature coefficients for the firn layer and various depths in the ice are included. The temperature regime of the glaciers in the Urals is characterized as being transitional from the sea type to the continental. The corrie glaciers, with "warm" firn basins, are classified as belonging to the sea type, the slope glaciers as being of the continental type. Ice temperatures beneath the active layers were found to be 6° to 7° C higher than the mean annual air temperatures at corresponding heights. This is explained by the thermoinsulating properties of the snow cover on the glaciers. Spatial variations of ice and firn temperatures at identical depths were noted on corrie glaciers, which is ascribed to snow accumulation and spatial ablation. Transl. by K.W.

N67-27158# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
PROCESSES OF ICE FORMATION AND GLACIER CONSTRUCTION
V. I. Mikhaliov *In its* Glaciation of the Urals, No. 16 1966 p 221–238 (See N67-27141 14-13)

The zones of ice formation of the glaciers of the Urals are affected by either the sea climate or the continental climate. The sea climate causes a "warm" firn zone, the continental climate results in a firn-ice zone and a zone of ice feeding. Deformation of textures due to the movement of ice is examined. The small changes in the layering are explained by the accumulation of snow covers. Successive snow accumulations and intensive ablations are also responsible for the visible annual layering. The slow movement of the ice insures retention of the primary layering over the entire glacier. Textures of firn and ice, the infiltration process in firn basins, and the icing process of the firn are analyzed. Transl. by K.W.

N67-27159# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
MATTER BALANCE OF GLACIERS
V. G. Khodakov *In its* Glaciation of the Urals, No. 16 1966 p 239–256 (See N67-27141 14-13)

Investigated were the processes of snow accumulation and ice formation; ablation of the ice, snow, and firn layers; movement; and the temperature regime of glaciers. The components contributing to the formation of the mass balance of glaciers are examined using data from glaciers of the Polar Urals region in general and specifically data of the glaciers Igan, Obruchev, and Olenyeg. These data are used to study and analyze changes in sections and in the total mass of glaciers. The calculation of components of the mass balance is based on detailed field measurements made during a six-year period. The budget of the mass balance for most of the corrie and corrie-valley glaciers was found to be negative, and only during the period 1961–1962 was the budget near zero. Most slope glaciers were found to have a slightly positive or a zero budget. For some glaciers a close connection between mass balance and air temperature was noted, and it was possible to reconstruct their values for the period from 1818 to 1963. In general, a considerable increase in the mass of glaciers is thought to have occurred in the past century; a noted decrease during the last decades of this century is primarily ascribed to warmer summers. Transl. by K.W.

N67-27160# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
HISTORY OF GLACIATION OF THE URALS
L. S. Troitsky *In its* Glaciation of the Urals, No. 16 1966 p 257–282 (See N67-27141 14-13)

Pleistocene and Holocene glaciation and the evolution of modern glaciation are discussed. Indications are that the Quaternary glaciation of the Urals developed only within the modern zone of high snow and water content and that it has always been of the mountain-valley and corrie type. Major cause for this type of glaciation was the transgression of the Arctic Ocean onto the plains of the Western Siberia and Pechora lowlands. Evidence exists of the sea and ice sea origin of Quaternary deposits covering these lowlands up to 60° N. Cover glaciation never developed. The age of corrie glaciers was determined from their relief formations and is estimated to be between 200,000 to 600,000 years. Transl. by K.W.

N67-27212# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.
ENERGY DISSIPATED BY ATMOSPHERIC EDDIES IN THE WAKE OF ISLANDS
E. M. Wilkins (Ling-Temco-Vought, Inc., Dallas) Feb. 1967 15 p refs
(Grant E-41-67(G))
(ARL-1576-1)

The dissipation rates for kinetic energy in the large eddies observed in the wake of three islands are calculated to be 22, 25, and 34 erg gm^{-1} sec^{-1} some three hours after the formation of the eddies. The tangential velocity at the visible edge of the eddy at that time is estimated to be about 14 knots. A periodic fluctuation in pressure should exist on the steep sides of the islands exposed tangentially to the free stream velocity vector. These pressure fluctuations, caused by flow separation during vortex shedding, would have a periodicity of eight to nine hours and a magnitude possibly as great as 2 mb. Assumption is made that the eddies are an atmospheric analog of the Karman trails observed in the laboratory, and that the two-dimensional theory built on these observations will suffice to describe the most important features of the atmospheric vortex trails. Author

N67-27241# Sandia Corp., Albuquerque, N. Mex.
DYNAMIC PENETRATION OF SELECTED PROJECTILES INTO PARTICULATE MEDIA
L. J. Thompson Jul. 1966 206 p refs
(Contract AT(29-1)-789)
(SC-RR-66-376) CFSTI: HC $3.00/MF $0.65

A study of the process of projectile penetration into soil is described. The governing differential equations for the soil target medium are developed using the equations of motion and the continuity condition. Constitutive relationships are derived from Mohr–Coulomb theory for a rigid plastic material and from viscosity theory. The other necessary equations are generated from an experimental investigation of the penetration mechanism. Author (NSA)

N67-27242# Sandia Corp., Albuquerque, N. Mex.
THE ATMOSPHERIC DENSITY EXPONENTIAL, SCALE HEIGHT, AND BASE DENSITY AS A FUNCTION OF ALTITUDE FOR SIX ATMOSPHERIC MODELS
H. R. Spahr Jan. 1967 144 p refs
(Contract AT(29-1)-789)
(SC-RR-66-2675) CFSTI: HC $3.00/MF $0.65

The variation of atmospheric density exponential, scale height, and base density with altitude are presented in tabular form for the following atmospheric models: interim high solar flux day atmosphere; interim high solar flux night atmosphere; interim low solar flux day atmosphere; interim low solar flux night atmosphere; 1959 ARDC model atmosphere, and 1962 U. S. Standard atmosphere. The variation of atmosphere density scale height with altitude is presented graphically for the above models. Four of the six atmospheric density models extend to altitudes of approximately 6 million feet. Author (NSA)

N67-27274*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TERRAIN PHOTOGRAPHY ON THE GEMINI IV MISSION: PRELIMINARY REPORT
Paul D. Lowman, Jr., James A. McDivitt, and Edward H. White, II Washington, NASA, Jun. 1967 19 p refs
(NASA-TN-D-3982) CFSTI: HC $3.00/MF $0.65 CSCL 08B

During the 4-day Gemini IV flight in June 1965, about 100 color pictures of land areas were taken with a 70mm hand-held camera for geologic and geographic study, as part of the Synoptic Terrain Photography Experiment. This paper presents a brief summary of the objectives, methods and results of the experiment. Representative pictures of the southwestern United States, northern Mexico, and portions of Africa and the Arabian peninsula are presented and described. Preliminary study indicates that these pictures will be useful in studying regional structure, revising small-scale geologic maps and searching for and studying impact structures. Author

N67-27307*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
TEKTITE COMPOSITIONAL TRENDS AND EXPERIMENTAL VAPOR FRACTIONATION OF SILICATES
Louis S. Walter May 1967 47 p refs
(NASA-TM-X-55781; X-641-67-221) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Recent observations indicate that Muong Nong type tektites, which are highly structured, contain coesite, and have a high silica content, may be primary tektite material. High-temperature experiments at atmospheric pressure show that, starting with material of this composition, vapor fractionation results in a residuum which follows the compositional trends of tektites in general. There is a significant difference between the tektite trends and those produced in experiments under reducing conditions. Author

N67-27352 Joint Publications Research Service, Washington, D. C.
THE INTERNATIONAL GEODETIC CONFERENCE IN HUNGARY
F. Deumlich 3 Mar. 1967 11 p Transl. into ENGLISH from Vermessungstechnik (Leipzig), no. 6, 1966 p 228–230 Conf. held at Budapest, 14–20 Apr. 1966
(JPRS-40118; TT-67-30764) CFSTI: $3.00

Conference papers are briefly reviewed. The general areas covered deal with the equipment and accuracy of horizontal, distance, height, and gravity measurements, and problems associated with geographic orientation. N.E.N.

N67-27380*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
A COMPUTER PROGRAM FOR VLF RAY TRACING IN A MODEL IONOSPHERE
Stanley D. Shawhan May 1967 71 p refs
(Grant NGR-16-001-043; Contract Nonr-1509(06))
(NASA-CR-84425; Rept.-67-12) CSCL 04A

The ray tracing equations and the expressions necessary to evaluate these equations for a model ionosphere with a centered dipole magnetic field and an H^+, He^+, O^+, e^- diffusive equilibrium concentration model are given and discussed. A basic computer program for the numerical calculation of ray paths in a meridian plane is listed and explained. An additional routine to calculate point-to-point ray paths is briefly described. Examples are given of the computer printout for this ray tracing program and of a plotted ray path. Author

N67-27383# Joint Publications Research Service, Washington, D. C.
NATURE OF SINKIANG AND FORMATION OF THE DESERTS OF CENTRAL ASIA
E. M. Murzayev 20 Mar. 1967 621 p refs Transl. into ENGLISH of the book "Priroda Sin'tszyana i Formirovaniye Pustyn' Tsentral'noy Azii" Moscow, 1966 p 3–373
(JPRS-40299; TT-67-30944) CFSTI: $3.00

Relief features of Sinkiang province and of the desert area of the Chinese People's Republic are described. Characteristics of the climate in the area; of the surface waters; of the soil mantle and vegetation cover; and of the animal kingdom inhabiting the area, are discussed. The history of the formation of this Central Asian landscape is given. Recent glaciation in the region is discussed. An extensive bibliography of source material is included. L.S.

N67-27388# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, No. 151
2 Mar. 1967 59 p Transl. into ENGLISH from the Russian
(JPRS-40106; TT-67-11147-151) CFSTI: HC $3.00

Abstracts, news summaries, translations, and bibliographic information from Sino-Soviet Bloc countries on subject areas covering (1) astronomy, (2) meteorology, (3) oceanography, (4) terrestrial geophysics, and (5) upper atmospheric and space research are presented. Specific topics include: (1) comets, (2) solar flare and activity cycles, (3) atmospheric scattering of light, (4) oceanographic acoustics, (5) geological structures, seismic waves, and magnetic field data, (6) ionospheric ionization, (7) meteor diffusion in atmosphere, and (8) reentry of spacecraft into the atmosphere, among other topics. L.S.

N67-27389# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 152
16 Mar. 1967 83 p Transl. into ENGLISH from the Russian
(JPRS-40291; TT-61-11147-152) CFSTI: HC $3.00

Abstracts, news summaries, translations, and bibliographic information from Sino-Soviet Bloc countries on subject areas covering (1) astronomy, (2) meteorology, (3) oceanography, (4) terrestrial geophysics, and (5) upper atmospheric and space research are presented. Specific topics include: (1) solar radiation magnetic storms, and flares, (2) air currents, temperature, and precipitation, (3) ocean currents, ice conditions, and thermal structure of sea, (4) seismographic signals, (5) space radiation and plasma densities recorded by satellites, and (6) planetary atmospheres, among other topics. L.S.

N67-27392# Joint Publications Research Service, Washington, D. C.
THE OUTER IONOSPHERE AND ITS TRANSITION TO THE INTERPLANETARY MEDIUM
Ya. L. Al'pert 1 Mar. 1967 42 p refs Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 90, no. 3, Nov. 1966 p 405–433
(JPRS-40082; TT-67-30729) CFSTI: HC $3.00/MF $0.65

Experimental data giving charged particle density distributions in the outer ionosphere as a function of height, are presented. Plots of particle densities, including electron densities, are depicted. Temperature effects on the energies of the particles in the regions were investigated, and the results are graphically depicted. A low frequency wave technique for processing the measured data, especially those signals called whistlers, is discussed; and mathematical expressions are used for the analysis. Also investigated were the noncoherent scattering of radio waves, and the inhomogenous formations in the outer ioniosphere. L.S.

N67-27398# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 155
2 May 1967 178 p refs Transl. into ENGLISH from Russian
(JPRS-40863; TT-61-11147-155) CFSTI: HC $3.00

Abstracts, news summaries, translations, and bibliographic information from Sino-Soviet Bloc countries on subject areas covering (1) astronomy, (2) meteorology, (3) oceanography, (4) terrestrial geophysics, and (5) upper atmospheric and space research are presented. Specific topics include: (1) lunar, Martian, and Venusian surface and atmospheric features, (2) solar radiation, (3) gravitational waves, (4) wind, temperature, and air turbulence profiles, (5) underwater laboratories, (6) ocean currents, (7) seismology, (8) satellite recordings of space radiation, and (9) meteor streams, among other topics. L.S.

N67-27462# Weather Wing (4th), Ent AFB, Colo. Solar Forecast Facility.
FORECASTING SOLAR ACTIVITY AND GEOPHYSICAL RESPONSES
30 Dec. 1966 68 p refs
(Rept.-4WWM-105-1; AD-648073) CFSTI: HC $3.00/MF $0.65

This publication presents the philosophy and the techniques involved in producing operational probability forecasts for the occurrence of solar flares and proton events, forecasts of 10-cm solar radio flux, and forecasts of the geomagnetic index Ap and describes the principal parameters and relationships to be considered and evaluated in making these forecasts. TAB

N67-27464# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.

GEOPHYSICS AND SPACE DATA BULLETIN, VOLUME III, NO. 3, THIRD QUARTER 1966

Anne L. Carrigan and Norman J. Oliver, ed. 1966 176 p

(AD-648046) CFSTI: HC $3.00/MF $0.65

The Bulletin is comprised of AFCRL inhouse and contracted data reported from various sites around the world. The following programs are represented: Total field intensity magnetometer; Cosmic ray neutron intensity monitor; Oblique high-frequency propagation; Riometer; Solar optical patrol observations; Solar radio emission; Vertical incidence ionospheric soundings. TAB

N67-27466# Braddock, Dunn and McDonald, Inc., El Paso, Tex.

TIME DEPENDENT NEUTRON TRANSPORT FROM A POINT ISOTROPIC SOURCE AT AN ALTITUDE OF (15.240 KM) 50,000 FT.

James P. George and Albert Lavagnino 17 Nov. 1966 271 p refs

(Contract DA-49-146-XZ-532)

(DASA-1820-III; AD-647165) CFSTI: MF $0.65

The results of a run of the Augeas Monte Carlo neutron transport code are presented. The neutron sources used are isotropic and monoenergetic, with source energies between 0.01 MeV and 14 MeV. The source altitude is 50 kilofeet in a reference atmosphere. A detailed rationale for locating the neutron detector is given. The neutron flux, resolved into 20 time intervals, and the neutron fluence, resolved into 16 energy intervals, is reproduced from the code output. Comprehensive total fluence curves are presented. Detailed flux vs. time and fluence vs. energy histograms are presented for the representative source energies 14 MeV and 1.4 MeV. Author (TAB)

N67-27468# Miami Univ., Coral Gables, Fla. Radar Meteorological Lab.

STUDY OF LIGHT ATTENUATION UNDER SUBTROPICAL CLIMATIC CONDITIONS Final Report, 1 Jul. 1963–30 Sep. 1966

H. W. Hiser, R. W. Robert, and C. L. Courtright Dec. 1966 336 p refs

(Contract DA-36-039-AMC-0352(E))

(Rept.-8209-2; AD-648131) CFSTI: HC $3.00/MF $0.65

Light propagation data from the four seasons of the year taken in the Florida Everglades at night during 1964 and 1965 are presented and analyzed. These show the attenuation of blue, green, red, and infrared light under tropical and subtropical conditions. Some concurrent polar nepholometer measurements of the light scattered from particles in a small volume of air as a function of the angle of incidence and reflection are included. The geographical site, equipment, and methods of data collection also are described. Author (TAB)

N67-27478# Stanford Univ., Calif. Radioscience Lab.

HEIGHT DETERMINATION OF RADAR ECHOES FROM METEOR TRAILS

Robert Nowak Dec. 1966 48 p refs

(Contract AF 19(628)-3996)

(SEL-67-001; AFCRL-67-0108; SR-3; AD-648080) CFSTI: HC $3.00/MF $0.65

When determining the height from which radar echoes from ionized meteor trails are received, the short duration of these echoes and the fairly low frequency needed to obtain them present problems not normally encountered in radar position finding. Four methods involving triangulation and angle measurements are investigated and measurement errors are analyzed. The particular choice of method for the Stanford meteor radar is explained and the system used is described. An inexpensive way to measure the height difference between two reflection points on a trail is indicated. Author (TAB)

N67-27542# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

COASTAL EFFECT IN AURORA

Yu. A. Nadoubovich 1967 80 p refs In RUSSIAN; ENGLISH summary

(Rept.-14)

The coastal effect dependency on auroral characteristics is discussed on the basis of 300,000 all sky photographs obtained by several cameras in the USSR during the IGY. Statistical analysis of the auroral geographical distribution showed that the maximum zone of homogeneous forms approaching the coast with increasing magnetic activity follows the coastal contours. Near the coast the azimuth variations of arcs are considerably increased while the frequency of appearance of homogeneous arcs is enhanced. The analysis of 201 cases of actual realization of the coastal effect confirmed that the phenomena is observed mainly in homogeneous arcs. Data on the distribution peculiarities of different forms of aurora are also presented; and cases of auroral splitting, and their oscillatory drift are described. Other aspects of the coastal phenomenon are also discussed. L.S.

N67-27550# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

MANUAL ON SHORT-TERM PREDICTION OF IONOSPHERIC GEOMAGNETIC STORMS AND RADIO-PROPAGATION FORECASTING SERVICE

R. A. Zevskina, E. V. Lavrova, and L. N. Lyakhova 1967 77 p ref In RUSSIAN; ENGLISH summary

The main features of ionospheric-geomagnetic storms and their probable causes are reviewed. Disturbances in short wave radio propagation during such storms are discussed. The principles of short term prediction of ionospheric-geomagnetic storms are summarized and all kinds of IZMIRAN's forecasts are described. The application of these forecasts and current ionospheric data to calculation of usable radio propagation frequencies is explained. The manual is of interest to radio communication operators and geophysicists engaged in this field of science. Author

N67-27563*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A LATITUDE SURVEY OF THE EQUATORIAL ELECTROJET WITH ROCKET-BORNE MAGNETOMETERS

T. N. Davis, K. Burrows, and J. D. Stolarik Jul. 1966 48 p refs

(NASA-TM-X-55787; X-612-66-334) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Experimentally determined profiles of ionospheric current density within and near the equatorial electrojet have been derived from magnetic field measurements obtained by rocket-borne rubidium vapor magnetometers. The lower boundary of the equatorial electrojet is near altitude 87 km. A steep vertical gradient in current density appeared near altitude 100 km and the maximum current density, 10 amp/km^2, was measured at an altitude of 107 km directly above the measured location of the magnetic equator. The profile of current density near the magnetic equator suggests that the layer conductivity σ_{xy} as well as the layer conductivity σ_{yy} affects the electrojet configuration and also that the electrojet distorts the magnetic field sufficiently to affect the layer conductivities. Using observatory and rocket measurements the induced H component of the magnetic field was found to be 0.3 of the H contribution from the ionospheric current. Author

N67-27574*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SUDBURY STRUCTURE, ONTARIO: SOME PETROGRAPHIC EVIDENCE FOR AN ORIGIN BY METEORITE IMPACT
Bevan M. French Feb. 1967 59 p refs
(NASA-TM-X-55789; X-641-67-67) CFSTI: HC $3.00/MF $0.65 CSCL 08G

The Onaping formation overlies the upper (micropegmatite) unit of the nickel-bearing Sudbury "irruptive," and is separated from it by a "quartzite breccia" composed of large blocks of quartzite with interstitial micropegmatite. Preliminary petrographic study by the writer provides evidence that inclusions of basement rocks in the Onaping formation show microscopic textures typical of rocks subjected to shock pressures generated by meteorite impact or by artificial explosions. These include: (1) planar features in quartz, concentrated at or near the (0001) and (1013) planes; (2) intense deformation and development of additional planar features in associated feldspar; (3) unusual deformational "flow textures" in single feldspar crystals which may represent the results of selective "melting" by shock. These features are also rarely observed in smaller fragments which constitute the matrix of the inclusions. These observations establish a strong similarity between Sudbury and other structures for which an impact origin is either proven or strongly indicated. Author

N67-27577*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HAS THE EARTH'S CRUST CHANGED WITH TIME? RARE-EARTH ABUNDANCES IN ANCIENT SEDIMENTS
C. C. Schnetzler and John A. Philpotts May 1967 12 p refs
(NASA-TM-X-55796; X-641-67-237) CSCL 08G

Ancient sediments were analyzed for their contents and abundances of rare earth trace elements by mass spectrometric stable-isotope dilution. Chondrite values used to normalize the obtained data showed that all sediments had similar relative rare earth abundances, although their absolute abundances differed by several orders of magnitude. Europium anomalies occurred in ancient as well as younger sediments and were attributed to redox conditions during sedimentation. G.G.

N67-27631# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
STRATIGRAPHY AND ABSOLUTE AGE OF DEEP-SEA SEDIMENTS IN THE WESTERN PACIFIC
E. A. Romankevitch, P. L. Bezrukov, V. I. Baranov, and L. A. Khristianova 1966 171 p refs In RUSSIAN; ENGLISH summary
(Rept.-14) CFSTI: HC $3.00/MF $0.65

Lithological studies of cores and their micropaleontological makeup served as a basis for distinguishing eight stratigraphic horizons in the deep-sea Quaternary deposits of the western Pacific. The upper ones of these horizons were traced from the Komandorskie and Aleutian Islands in the north to the Marshall Islands in the south. Vertical distribution regularities of U 238, Th 232, Th 230, and Ra were ascertained in 14 cores; rates of sedimentation and absolute age of separate horizons were computed from this data. Evidence was found to confirm the conclusion that in temperate and tropical regions of the Pacific Ocean cold as well as warm climate periods occurred simultaneously. The horizons were compared with the stratigraphic scheme of Quaternary deposits in western Europe. Laboratory methods for determining granulometric and chemical composition of sediments are described. Deep-sea sediment analyses were also used to study phases in the last ice age of the Earth. K.W.

N67-27646*# Alaska Univ., College. Geophysical Inst.
HIGH LATITUDE GEOPHYSICAL DATA, OCTOBER–DECEMBER 1966
V. P. Hessler, ed. Dec. 1966 111 p
(Contract NAS5-3595)
(NASA-CR-84491; UAG-C-46) CFSTI: HC $3.00 CSCL 04A

High latitude geophysical data related to polar ionospheric activity are presented in graphical and tabular form for the months of Oct. through Nov., 1966. Included are traces of the 30 Mc/s cosmic noise level, records and scalings of telluric current activity, frequency-time displays of telluric current activity, telluric micropulsation activity recordings, and tables of geomagnetic activity. C.T.C.

N67-27648*# Alaska Univ., College. Geophysical Inst.
HIGH LATITUDE GEOPHYSICAL DATA, JULY–SEPTEMBER 1966
V. P. Hessler, ed. Sep. 1966 112 p ref
(Contract NAS5-3595)
(NASA-CR-84494; UAG-C-45) CFSTI: HC $3.00 CSCL 04A

Graphical and tabular geophysical data related to polar ionospheric activity are presented for the months of July through September, 1966. These data include records and scalings of telluric current activity, frequency-time displays of telluric current activity, telluric micropulsation activity recordings, traces of 30 Mc/s cosmic noise, and tables of geomagnetic activity. C.T.C.

N67-27658*# Volt Technical Corp., Washington, D. C.
MAGNETIC CHART OF THE BRAZILIAN ANOMALY [MAGNITNAYA KARTA BRAZIL'SKOY ANOMALII]
L. V. Konovalova and V. I. Nalivayko 23 May 1967 4 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 7, no. 2, 1967 p 394–395
(Contract NAS5-12487)
(NASA-CR-84489; ST-GM-10611) CSCL 04A

A magnetic chart of the Brazilian anomaly has been drawn on the basis of magnetic field measurements by proton magnetometers installed on AES Kosmos-49 and Kosmos-26. Author

N67-27710# Academy of Sciences (USSR), Moscow.
WAVE HEIGHTS IN THE NORTHERN PART OF THE ATLANTIC OCEAN. OCEANOLOGY X SECTION OF IGY PROGRAM NO. 16
K. I. Kashin 1966 88 p refs In RUSSIAN

Consideration is given to the meteorological factors, and the synoptic processes in calculating and forecasting the properties and forms of waves in the North Atlantic. Emphasis is placed on the wind and pressure effects, their relationships, the diurnal variations, and the development of methods for predicting wave heights. E.T.C.

N67-27713# Academy of Sciences (USSR), Moscow.
MOUNTAINS OF THE CENTRAL PART OF THE QUEEN MAUD LAND (EASTERN ANTARCTICA)
V. I. Bardin 1966 112 p refs In RUSSIAN; ENGLISH summary
(Rept.-15)

A regional geographical summary is presented of surface and aerial observations of the mountainous regions of Eastern Antarctica. Included are data related to the formation of the terrain, vegetation growth, the possibility of further geological research, and the effects of erosion. E.T.C.

N67-27719# Stanford Univ., Calif. Radioscience Lab.
A CORRELATION STUDY OF THE DIURNAL VARIATION OF UPPER ATMOSPHERIC GEOPHYSICAL PHENOMENA IN THE SOUTHERN AURORAL ZONE
H. M. Morozumi and R. A. Helliwell Dec. 1966 130 p refs
(Grants NSF G-23817; NSF GA-56; NSF GA-144)
(SU-SEL-66-124; SR-2) CFSTI: $3.00

As a part of a high-latitude study of vlf emissions, the temporal relationships among eight upper atmosphere phenomena were investigated. The following quantities were recorded during the austral winter and spring of 1963: (1) vlf noise (1–25 kc broadband); (2) aurora (5577Å and white light); (3) ionospheric absorption (30 Mc/s riometer); (4) vlf noise (1 kc/s narrowband); (5) elf (2–30 cps); (6) ulf (0.001–5 cps); (7) variations in the earth's magnetic field (standard magnetometer); and (8) ionospheric phenomena (C-3 ionosonde). Author

N67-27749 International Geophysical Year World Data Center A, Washington, D. C.
CATALOGUE OF DATA IN WORLD DATA CENTER A—AIRGLOW, IONOSPHERE, AURORA (INSTRUMENTAL), AURORA (VISUAL), COSMIC RAYS, GEOMAGNETISM, AND SOLAR ACTIVITY, 1 JULY 1957–31 DECEMBER 1966
Feb. 1967 160 p refs

Tables are presented containing data on cosmic rays; airglow; the ionosphere, including vertical soundings, electron density, absorption, ionospheric drift, atmospheric radio noise, and whistlers; aurora, instrumental and visual; geomagnetism; and solar activity, including Wolf sunspot numbers, solar flares, radio emission, calcium plages, solar magnetic fields, and comet observations. L.E.W.

N67-27768# Library of Congress, Washington, D. C. Aerospace Technology Div.
OPTICAL RANGING SURVEYS OF FOREIGN SCIENTIFIC AND TECHNICAL LITERATURE
Frederick Pindy 23 Nov. 1966 57 p refs
(ATD-66-130) CFSTI: HC $3.00/MF $0.65

This compilation of abstracts is based on Soviet open sources published 1964–1966. The material covers: I) General topics; II) Interaction of light with the atmosphere; III) Atmospheric distribution of water particles, aerosols, and impurities; and IV) Surface and ground cover reflectivity, absorption, and transmission. An Author index appears at the end of the report. Abstracts include the following information: physics of roughly dispersed aerosols; spectral transparency of the atmosphere; automatic spectroscopic device for investigation of the transmission of solar IR radiation through the atmosphere; limit cases of the distribution of paths of photons emerging from a thick scattering layer; importance of the polarimetric method of investigating the turbidity of the earth's atmosphere in comparison with the actinometric and diaphanoscopic methods; daily cycles of dustiness of the lower layers of the atmosphere; Junge's size distribution of particles and some properties of the atmospheric scattering indicatrix; and measurement of the true absorption index of light in the sea. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N67-26485# Rome Univ. (Italy). Instituto di Chimica Biologica.
KINETIC STUDIES ON HEMOGLOBIN BY FLASH PHOTOLYSIS Final Scientific Report, 1 Dec. 1965–31 Jan. 1967
Eraldo Antonini 31 Jan. 1967 7 p refs
(Grant AF-EOAR-66-22)
(AFOSR-67-0521; AD-648666) CFSTI: HC $3.00/MF $0.65

The kinetics of the reactions of human hemoglobin of isolated alpha and beta chains of hemoglobin (with free and parachloromercury benzoate bound SH group) and of myoglobin with O2 and CO were studied by flash photolysis, under a variety of conditions. For the isolated hemoglobin chains the velocity constants for the reaction with CO obtained by flash are higher (up to 30 70%) than those obtained in rapid mixing experiments. Values for the velocity constant for combination of isolated hemoglobin chains with O2 were measured. These values are higher than those predicted from values of equilibrium constant and dissociation velocity constants. The origin of rapidly reacting forms of hemoglobin on flash photolysis was investigated. The rapidly reacting form appearing at pH 7 in dilute hemoglobin solutions was correlated to differential aggregation of ligand bound and deoxy hemoglobin. A study of the quantum yield for photodissociation of CO heme proteins was carried out. The relation, supposed in the past, between quantum yield and state of polymerization of the heme proteins, was disproved, the quantum yield appearing to depend primarily on the primary structure of the protein. Author (TAB)

N67-26493# Naval Ordnance Lab., White Oak, Md.
A DEEP SEA CERAMIC CAPSULE AND OTHER MAGNETOMETER CONSTRUCTIONS
Abraham Silverstein and Frank G. Salton 22 Dec. 1966 25 p refs
(NOLTR-66-164; AD-648634) CFSTI: HC $3.00/MF $0.65

The mechanical design and building procedures are given for two underwater magnetometer structures. First the ceramic housing for the Helium Precession Magnetometer is described, followed by the Deep Dip loop magnetometer. Both are capable of withstanding any sea depth. Author (TAB)

N67-26513*# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
INSTRUMENTATION FOR MEASUREMENT OF COSMIC NOISE AT 750, 1225, AND 2000 KHZ FROM A ROCKET Final Technical Report
W. J. Lindsay, H. W. Estry, D. D. Majeske, R. L. Miller, and D. Walsh Feb. 1967 144 p refs
(Grant NsG-572)
(NASA-CR-84151; Rept.-67-2) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Descriptions are given of the design considerations and performance characteristics of a complete rocketborne instrumentation system for absolute intensity measurements of radio frequency noise energy. The instrumentation was designed to make simultaneous cosmic noise measurements at frequencies of 750, 1225, and 2000 kHz while immersed in, or above, the ionosphere. The instrumentation includes an antenna impedance measuring system that operates during flight. Procedures used for preflight and in-flight noise calibrations are discussed. A description is given of the ground equipment used to prepare the flight telemetry data for computer processing. The payload was launched June 30, 1965 from Wallops Island, Virginia, to an altitude of 1,057 statute miles and all instrumentation functioned perfectly. Author

N67-26514*# General Applied Science Labs., Inc., Westbury, N. Y.
DEVELOPMENT OF AN ELECTRON DENSITY PROBE Final Report, 28 May 1965–28 Feb. 1966
Hector Medecki and David Attwood 26 Jun. 1966 136 p refs
(Contract NAS5-9881)
(NASA-CR-84150; TR-594) CFSTI: HC $3.00/MF $0.65 CSCL 14B

An electron density probe has been developed to measure from 10^{10} to 10^{14} e/cm^3. The probe is basically an open non-radiating electromagnetic cavity whose resonant frequency is uniquely related to the electron density of the surrounding medium. The calibration of this instrument has been performed with real and simulated plasmas. Particular emphasis has been placed on an application in the separated flow region of a reentry Apollo spacecraft for a typical trajectory. The effects of heat transfer and diffusion of charged particles upon the operation of the probe have been estimated for those conditions. A preliminary design of a system for this in-flight measurement is presented. Author

N67-26538*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
GYRO AND ACCELEROMETER TEST PLATFORM
J. T. Egan *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 109–111 (See N67-26521 14-21)

Work was initiated on a working model of a stabilized testing platform and test table to evaluate any accelerometer and gyros which may be developed in the next decade. The NASA-Electronic Research Center facility is to achieve vibration isolation through servo control so that, within reasonable limits, a test area may be set up in any convenient room. This program will also isolate against higher frequency disturbances than previous efforts. Pertinent technical details of the program are very briefly outlined. R.Ll.

N67-26540# DuPont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
SOLID-STATE PLUG-IN CIRCUITS AS INSTRUMENT BUILDING BLOCKS
William J. Woodward Jan. 1967 16 p
(Contract AT(07-2)-1)
(DP-1079) CFSTI: HC $3.00/MF $0.65

Seven standard solid-state circuits were developed for use in radiation instrumentation. These circuits are a pulse amplifier, a variable discriminator, a pulse-shaping univibrator, a counting tube (dekatron) driver, a count rate meter, and multiple range and time constant circuits to operate with the count rate meter. These circuits may be combined to make instruments for specific needs. R.Ll.

N67-26541*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A COMPUTER-CONTROLLED CENTRAL DIGITAL DATA ACQUISITION SYSTEM
Charles Mealey and Leslie Kee Washington, NASA, May 1967 17 p ref
(NASA-TN-D-3904) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A central digital data system incorporating a small general purpose digital computer as the heart of the system is described. The system is designed to operate automatically in recording up to 500 voltage and 500 pressure measurements from each of 100 test facilities. Any three test facilities may be recording simultaneously along with data playback by typewriter or plotter to any three of the 100 users. Voltage measurements are recorded at up to 500 samples per second while all pressure measurements are taken during a 10-second interval. Other important features of the system are as follows: (1) Magnetic drum storage provides data buffering and storage capacity for test control programs for all 100 experiments. (Service to any 100 users can be provided within 1 sec after request.) (2) The system has a direct magnetic core interface with a large data processing digital computer, which permits limited online processing. (3) An alpha-numeric cathode ray tube display and keyboard is integrated into the control console for the display and communication of important operating and maintenance information. (4) The system records the data on magnetic tape in the processing computer format. Author

N67-26588*# Stanford Research Inst., Menlo Park, Calif.
DESIGN OF AN OPTOMETER AND TWO-DIMENSIONAL EYE TRACKER Final Report
Tom N. Cornsweet and Hewitt D. Crane Apr. 1967 67 p refs
(Contract NAS2-3517)
(NASA-CR-73088) CFSTI: HC $3.00/MF $0.65 CSCL 14E

A technique for two-dimensional tracking of eye position is described. This technique involves the projection of an infrared pattern into the eye and a measurement of the spatial separation of the first and fourth Purkinje reflections—the reflections from the front of the cornea and back of the lens, respectively. Because the first reflection is from a positive mirror and the fourth from a negative mirror these reflections move in opposite directions under eye rotation, but together under eye translation. By measuring the spatial separation of the two images we therefore obtain a measure of the rotational position of the eye that is not contaminated by artifact from translational movements of the eye. On the basis of preliminary results we have designed an experimental model that should provide tracking over a two-dimensional field at least several degrees in diameter and with an accuracy of 5 minutes of arc or better. The design of an optometer that gives a continuous real-time measure of the total refraction of the eye is also described. Author

N67-26590*# Avco Corp., Tulsa, Okla. Electronics Div.
VAN ALLEN BELT DOSIMETRY SYSTEM Final Report
G. C. Amey 15 Apr. 1967 33 p
(Contract NAS9-6158)
(NASA-CR-65629) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The tasks of this program have been design modifications, flight package design, fabrication of flight hardware and mock-ups, and testing of the final instruments to ensure satisfactory performance for the Apollo application. Included in the work was the fabrication of six flight-rated, dual sensor instruments, two mechanical mock-ups, and one electronic compatibility test unit. Each instrument contained two independent sensor systems, one for measuring surface dose rate and the other for measuring dose rate at a 5 cm. depth in tissue. Each sensor system was capable of measuring dose rates from 0.001 to 100 rad/hr. Author

N67-26595*# Ball Bros. Research Corp., Boulder, Colo.
SUN SENSOR DESIGN AND ENVIRONMENTAL REQUIREMENTS STUDY FOR THE ADVANCED PIONEER SPACECRAFT Final Report
J. R. Bancroft 10 Jan. 1967 198 p refs
(Contract NAS2-2450)
(NASA-CR-73086; F66-15) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Two fundamentally different sun sensor design concepts were devised to meet the Advanced Pioneer mission requirements of two complete elliptical orbits around the sun, each having a 0.2 AU perihelion and a 1.0 AU aphelion. The effects of micrometeorites and of earth reflected sunlight were considered, anticipated corpuscular and electromagnetic radiation environments were examined, and various detector materials were evaluated. It was concluded that the sensor which requires automatic gain control electronics but no moving parts is the more promising design, with *N-on-P silicon* considered the most practical photosensitive material for the sensor application. Two sensors were fabricated, along with a breadboard of the electronic system, and a 25:1 solar intensifier test fixture. Performance and environmental tests were conducted to determine sensor linearity, cross coupling, null stability, and radiation damage effects. Results indicate that the sensors can perform well in missions involving significant variation in irradiance level and target subtended angle. M.G.J.

N67-26633*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRINCIPLES OF OPTICAL DATA PROCESSING FOR ENGINEERS
A. R. Shulman Aug. 1966 29 p
(NASA-TM-X-55767; X-521-66-434) CFSTI: HC $3.00/MF $0.65 CSCL 14E

This document is primarily written for engineers as a self teaching text on optical data processing. Basic fundamentals necessary for understanding the subject are reviewed and expanded upon to give a clear understanding and working knowledge of the entire area, including: optical spectrum analysis, optical correlation, photographic film characteristics, and holography. In addition, this document introduces the use of mathematics to describe the various optical operations, thus forming a background for understanding more advanced works in the field. Author

N67-26662# Army Electronics Labs., Fort Monmouth, N. J.
PIEZOELECTRIC CERAMIC KEYBOARD TRANSDUCERS (PHASE I)
Abraham Rand and Victor Vajo Dec. 1966 34 p
(ECOM-2786; AD-647974) CFSTI: HC$3.00/MF$0.65

Solid-block piezoelectric ceramics were cut and tested under controlled conditions simulating impacts on a light-touch typewriter keyboard. Test setups were developed to provide a controlled mechanical impact and to monitor the resulting electrical output. Tests were applied to plastic-bonded, epoxy-bonded, and unbonded elements, and to several different configurations of single and paired elements. Comparison were in terms of absolute system efficiency based on the assumption that there was a single dominant mode of a damped sinusoidal output signal appearing across the terminal and load capacitors. Results show that plastic-bonded structures are very lossy and are also non-linear. Unbonded, clamped elements are linear over a range greater than 10/1 in input energy, and are also more efficient. Paired elements provided peak outputs in excess of one volt-milliampere for periods over 25 micro-seconds. Preliminary experiments indicate that flatting of mating surfaces results in improved output, and that shape approaching a cube is most efficient. There was little difference between epoxy-bonded units, clamped units, and bonded units with pyramid-shaped anvils.
Author (TAB)

N67-26669# ARO, Inc., Arnold Air Force Station, Tenn.
CALIBRATION CAPABILITIES OF THE ESF INSTRUMENT BRANCH
C. L. Owens Arnold Eng. Develop. Center, Mar. 1967 56 p
(Contract AF 40(600)-1200)
(AEDC-TR-67-18; AD-648707) CFSTI: HC$3.00/MF$0.65

To gather the required performance test data at the AEDC, a complex network of test instrumentation and data gathering equipment must operate as a system. Reliable test data depend upon the reliability of each individual unit of the system; therefore, known standards must be established to meet specific requirements. In addition, various research groups are engaged in special projects often requiring some accuracy level in the measurement of physical variables. In todays technology of the space age, pressure is continuously exerted to obtain greater performance from all systems. Increased performance of complex systems and the necessary interchangeability of components require measurements of known accuracy or compatibility in a variety of quantities. The purpose of this document is to present the hierarchy of measurements for various units that are derived from national standards and disseminated through the ESF Instrument Branch. This information should enable the users of measuring equipment to better know the capability of their equipment and to have confidence in the results obtained by specifying the level of calibration desired.
Author (TAB)

N67-26704# Pennsylvania State Univ., University Park. Dept. of Physics.
RESOLUTION AND EFFICIENCY OF SINGLE AND DOUBLE PASS SPECTROGRAPHS
J. A. Lowenthal, D. H. Rank, and T. A. Wiggins *In its* [Res. Proj. of the Dept. of Phys.] 31 Dec. 1966 refs Supported by ONR and NSF (See N67-26703 14-16)

The dispersion, resolution, and signal to noise ratio in single and double pass use of spectrographs are discussed. A theoretical ratio of single to double pass dispersion is derived for a non-Littro spectrograph. The resolution that can be expected is computed by convolution of the appropriate Doppler, Lorentz, and Schuster line profiles. A method for choosing between single and double pass operation to optimize the signal to noise ratio for a given resolving power is described. The measured dispersion, resolution, and signal to noise ratio of a 5 m vacuum spectrograph using a 12×25 cm grating are compared to the computed values. The results indicate that the resolution obtained is essentially the same as the

N67-26743# Army Materials Research Agency, Watertown, Mass.
ULTRASONIC SPECTROSCOPY
Otto R. Gericke Dec. 1966 19 p refs
(AMRA-TR-66-38; AD-647918) CFSTI: HC$3.00/MF$0.65

Various experimental difficulties discussed in the report had to be overcome to be able to adopt spectroscopic procedures for ultrasonic testing and to construct an ultrasonic spectroscope. The ultrasonic pulse-echo spectroscope recently developed and its practical use for nondestructive inspection purposes are described. Test results obtained with the instrument indicate its usefulness for determining defect characteristics which cannot be revealed by conventional ultrasonic test methods. In addition, it is shown how the ultrasonic spectroscope can be used to distinguish microstructures of steel specimens.
Author (TAB)

N67-26749# Advanced Technology Corp., Timonium, Md.
RESEARCH STUDY INTO THE NEAR EARTH APPLICATION OF MILLIMETER RADIO WAVES AS APPLIED TO CERTAIN BATTLEFIELD PROBLEMS Interim Technical Report, 19 Jul. 1965–31 Oct. 1966
John M. Cotton, Jr. and John W. Dozier 30 Nov. 1966 60 p
(Contract DA-18-001-AMC-829(X))
(AD-648732) CFSTI: HC$3.00/MF$0.65

The report summarizes the work done in developing three broadband millimeter wave components: a mechanical modulator, a tunable bandpass filter, and a second harmonic mixer. All the components were designed to operate throughout the 75-110 GHz frequency region. The ultimate application of these particular components was a tunable radiometer capable of operation through the vicinity of the 94 GHz window. The text describes the techniques used to fabricate the items and gives performance data on the components singly as well as on the completed radiometer assembly.
Author (TAB)

N67-26751# School of Aerospace Medicine, Brooks AFB, Tex.
DETERMINATION OF THE TRANSMISSION CHARACTERISTICS OF AUTOANALYZER COLORIMETER FILTERS
Chandler S. Cheek Dec. 1966 11 p
(SAM-TR-66-101; AD-648712) CFSTI: HC$3.00/MF$0.65

The sample compartment of the Beckman DK-2A ratio recording spectrophotometer was modified to permit the determination of the transmission characteristics of the interference filter supplied by Technicon Instruments Corporation. More accurate measurements can be made in matching the sample and reference filters and in matching the filters to the point of maximum absorption of the chromophore using this technic.
Author (TAB)

N67-26754# ARO, Inc., Arnold Air Force Station, Tenn. Propulsion Wind Tunnel Facility.
DIGITAL COMPUTER ORIENTED METHODS FOR DETERMINING THE RESPONSE OF PRESSURE MEASUREMENT SYSTEMS TO STEP AND RAMP FORCING FUNCTIONS
M. L. McKee Arnold Eng. Develop. Center, Jun. 1963 65 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-225; AD-648457) CFSTI: HC$3.00/MF$0.65

Theoretical equations for unsteady, compressible, laminar flow in cylindrical tubing were derived for pressure measuring systems comprised of up to three tube sizes connected to constant volume transducers. The basic equations were solved for both step and ramp pressure input forcing functions. Digital computer programs were written to be used as engineering tools for rapid determination of system characteristics. Examples of the ability of

the programs to compare tubing systems, optimize diameters, generate time responses to synthesized forcing functions, and determine lag times, distortion, and attenuation are presented as guides for prospective users of the programs. Author (TAB)

N67-26787# Observatoire de Paris (France). Service Solaire.
LAMBDAMETER NO. 2
In its Pt. 1: Res. on the Heterogeneous Struct. of the Solar Atmosphere 31 Oct. 1966 p 8–22 refs (See N67-26785 14-29)

Described is an instrument for measuring and recording local displacements in wavelength of Frauenhofer lines due to the Doppler and/or Zeeman effect from a photograph of the spectrum. Data on the principles of operation, mechanical design, and electrical design are included. S.C.W.

N67-26812# Ballistic Research Labs., Aberdeen Proving Ground, Md.
TECHNIQUES FOR FABRICATING FAST RESPONSE HEAT TRANSFER GAGES
Donald T. Knauss Sep. 1966 17 p refs
(BRL-TN-1629; AD-648041) CFSTI: HC $3.00/MF $0.65

It is necessary to use high response instrumentation in hypervelocity test facilities. High response gages presently being used to measure heat flux are the thin-film and thick-film types. Special techniques have been developed for fabricating both types for use in research programs in the Ballistic Research Laboratories (BRL) expansion tube. The thin-film gage has a cured metallic film bonded to an insulator substrate. Optimum firing conditions for curing and bonding have been determined. The data reduction equations necessary to interpret the results of the gage have been developed from a mathematical model. A more recent approach for measuring heat flux is the use of a thick-film gage. The fabrication of this type of gage involves the use of platinum strips or a combination of platinum strips and thin-films. The governing equation used in the design of this gage and the interpretation of results is simply the expression for heat storage in a material. Evaporative coating can be used to electrically insulate the heat flux gages; there is a brief discussion of optimum coating conditions, coating materials, and rate of deposition. Author (TAB)

N67-26835# Oak Ridge National Lab., Tenn.
SEMIAUTOMATIC PREPARATION OF SPECIMENS FOR TRANSMISSION ON ELECTRON MICROSCOPY
C. H. Du Bose and J. O. Stiegler Feb. 1967 35 p refs
(Contract W-7405-ENG-26)
(ORNL-4066) CFSTI: HC $3.00/MF $0.65

A rapid expansion in the use of transmission electron microscopy led to the development of new equipment designed to produce specimens of a variety of materials, often after neutron irradiation, in a quick and reliable manner. Specimens are cut, in a hot cell if necessary, to a thickness of about 20 mils and a maximum diameter of 1/8 in. These are first "dimpled" on both sides by an electrolytic jet technique to reduce the thickness of the center of the specimen to about 2 mils. The shape of the dimple bottom is controlled by varying the current density; and under appropriate conditions large, flat-bottomed dimples can be formed. Final polishing is accomplished in a standard electrolytic polishing cell in which breakthrough in the dimpled region is detected by an extremely sensitive photocell device. Incident light is piped to the specimen and the light transmitted through the hole is delivered to the photocell by a fiber-optics system. This system provides a small, intense light beam and also eliminates interference from thermal fluctuations of the polishing solution and radiation effects on the photocell. Activation of the photocell stops the polishing action in the final step. With this technique, extremely small holes can be detected, which usually are surrounded by reasonably large areas transparent to 100 kV electrons. Full details on design of the equipment and operations of the techniques are included. Author (NSA)

N67-26870# Matsushita Research Inst. Tokyo, Inc., Kawasaki (Japan). Electron Device Lab.
STUDIES OF INFRARED IMAGE CONVERTER. (SOLID-STATE TYPE AND VACUUM TYPE) Progress Report, 19 Jun.–18 Dec. 1966
Koh-ichi Miyaji Dec. 1966 157 p refs
(Contract DA-92-557-FEC-38337)
(J-255-3; AD-647649) CFSTI: HC $3.00/MF $0.65

Theoretical and experimental studies were performed in an effort to obtain an infrared image converter. The program was divided into three parts. Part I was concerned with the physics and material research in terms of the image conversion. Efforts were devoted to a study on the infrared photoconductive materials with high sensitivity in the near infrared region, and on the photoconductor which shows good photoconductive quenching properties. Some analysis of quenching mechanism was also done. Part II covered all kind of the solid state infrared image converters suitable to the infrared region. Effort of this interval efforts were concentrated to three problems: the photoconductor quenching system, direct receiver of the infrared image, and the highly sensitive image converter system. Part III was another approach to the infrared image converter. Possibility of a new type photocathode suitable to the infrared region was studied. For this purpose p-Si-Al diode was taken up, and photoinduced Hot Electron Emission was experimentally observed. Some improvement of emission was obtained. Further, the analysis of Emission and some new proposals were described. Author (TAB)

N67-26907# Space-General Corp., El Monte, Calif. Geosciences Dept.
PASSIVE MICROWAVE MEASUREMENTS OF SNOW AND SOIL: A STUDY OF THE THEORY AND MEASUREMENTS OF THE MICROWAVE EMISSION PROPERTIES OF NATURAL MATERIALS Technical Report, 6 May–31 Dec. 1966
J. M. Kennedy, R. M. Mandl, G. A. Poe, and R. T. Sakamoto 20 Feb. 1967 64 p refs
(Contract Nonr-4767(00))
(SGC-829R-5; TR-3; AD-648818) CFSTI: HC $3.00/MF $0.65

The first part of the report is a general review of techniques for measuring the dielectric constant of materials at frequencies in the millimeter and centimeter regions of the electromagnetic spectrum. The general survey shows that for the purpose of obtaining dielectric properties of in situ natural materials and laboratory measurements of natural materials, the reflection-polarization (ellipsometric) system is most practical and applicable. Following the review of various systems, SGC develops the relationship between dielectric constants and power reflection coefficients showing fundamental dependency of each of these parameters on the other. In the final section, the relationship of the dielectric constant to the physical conditions of snow is fully developed. In this section, SGC shows there is a unique dielectric constant for snow when the melt condition (free water content) and density are specified. Using this relation and the relationship between dielectric constant and Fresnel reflection coefficients, radiometric temperature, polarization, and angle of observation may be used to fully analyze snow from a remote platform. Author (TAB)

N67-26914# Naval Ordnance Test Station, China Lake, Calif.
THERMOELECTRIC VAPOR PRESSURE OSMOMETRY
Arnold Adicoff and Warren J. Murbach Mar. 1967 36 p refs
(NOTS-TP-4247; AD-648377) CFSTI: HC $3.00/MF $0.65

The thermoelectric vapor pressure osmometer is established as a satisfactory instrument for the determination of the vapor pressure lowering of solutes in solutions. The calibration constant, a sub 1, of the instrument is demonstrated to be independent of the nature of the solute and can be calculated from a knowledge of the system geometry and measurable thermodynamic and transport parameters. Experimental results are evaluated in terms of the change in resistance of the thermistor and the concentration of solution. It is necessary to use a second-degree equation in concentration plot to fit the data. Evaluation of the coefficient of the second-order term requires the incorporation of a heat-of-mixing term in the form of the Van Laar equation. The concentration-independent term beta for the heat of mixing is obtained for four-teen solute-solvent pairs. Author (TAB)

N67-26919# Wisconsin Univ., Madison. Dept. of Meteorology.
DOUBLE BOLOMETER MEASUREMENTS OF THE EFFECTS OF ATMOSPHERIC RADIATORS
Peter M. Kuhn, Robert A. Ragotzkie, and Velayudh K. Menon Jan. 1967 22 p refs
(Contract Nonr-1202(07))
(TR-30; AD-648521) CFSTI: HC $3.00/MF $0.65

The feasibility and testing of an air-borne, double bolometer (radiometer) technique for deriving atmospheric water vapor profiles at modest cost is illustrated. To achieve these results with shelf equipment, the radiative transfer equations are solved for the water vapor transmissivity at aircraft holding levels using observed upward irradiances as input data. The transfer solutions are obtained from computer programs developed specifically for this purpose. Results indicate an accuracy at least as good as that of the standard sounding electrical hygrometer but with measurements obtained at levels much higher than those at which hygrometer observations are possible. The implications for use on high-flying jet or special purpose aircraft or on rockets are presented. Author (TAB)

N67-26942# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
DESIGN AND CONSTRUCTION OF A CRYOGENIC LIQUID LEVEL-TEMPERATURE TRANSDUCER
William E. Alexander Oct. 1966 16 p refs
(AFFDL-TR-66-179; AD-648981) CFSTI: HC $3.00/MF $0.65

The report summarizes the design and construction of a cryogenic liquid level-temperature transducer. Its sensitive element is a flattened Chromel-Alumel thermocouple. The element is heated radiantly producing an above ambient temperature output signal. The output increases 6.5 millivolts when a drop in liquid level occurs. Ambient temperatures are monitored when the thermocouple is not heated. Author (TAB)

N67-26952# Northern Forest Fire Lab., Missoula, Mont. Intermountain Forest and Range Experiment Station.
PROJECT FIRE SCAN: FIRE DETECTION Interim Report, Apr. 1962–Dec. 1964
Ralph A. Wilson and Nonan V. Noste Jun. 1966 67 p refs
(Contract OCD-OS-62-174; ARPA Order 636)
(INT-25; AD-647136) CFSTI: HC $3.00/MF $0.65

The first 3 years of Project Fire Scan's airborne infrared fire detection program are reported. The program objective is the evaluation of systems and techniques for the detection of incipient forest fires. Qualitative correlations are presented of probability of detection versus scanner aspect angle, timber type, and fire target size. Aircraft patrol navigation requirements are briefly examined. A capability is demonstrated for precise observations of timber canopy obscurations from a fixed, ground platform. Appendixes include theoretical discussions of system spectral response, scanner sensitivity, of system spectral response, scanner sensitivity, source background radiometric detection criteria, and the several mechanisms of radiation attenuation. TAB

N67-26958# Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina). Laboratorio de Radiaciones.
ELECTRON–GAMMA AND ELECTRON–ELECTRON COINCIDENCE SPECTROMETERS WITH SEMICONDUCTOR COUNTERS Interim Report, Mar.–Dec. 1966
Horacio E. Bosch, E. Szichman, A. Baseggio, and R. Dolinkue Dec. 1966 20 p refs
(Grant DA-ARO-49-092-66-G121)
(LR-12; AD-648979) CFSTI: HC $3.00/MF $0.65

A special vacuum chamber containing a lithium-drifted silicon detector and the radioactive source was designed for electron-gamma coincidences. The gamma rays were detected outside it with conventional scintillation counters. A further modification of this chamber was done placing into it a second silicon detector in front of the former, thus obtaining an electron-electron coincidence spectrometer. Conversion coefficients corresponding to the transitions of 0.161 MeV and 0.0795 MeV in Cs-133 were determined. An additional measurement of the conversion coefficient corresponding to the 0.279-MeV transition in Tl-203 was performed by means of beta continuum-electron conversion coincidences. Author (TAB)

N67-26994# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
A LINEAR-MOTION BENT-CRYSTAL GAMMA-RAY SPECTROMETER
O. H. Otteson, W. F. Edwards (Utah State Univ.), and R. G. Helmer Jan. 1967 56 p refs
(Contract AT(10-1)-1230)
(IN-1025) CFSTI: HC $3.00/MF $0.65

A new design of a bent-crystal spectrometer is described. The diffraction crystal moves only in translation (i.e., without rotation) as a means of changing the Bragg angle. Details of the design and construction of the spectrometer are presented including a discussion of the diffraction angle measuring system. The testing and calibration of the spectrometer is also described. The line broadening that results from the source being off the focal circle is discussed. For the special case of scanning the energy range of 88 to 620 keV without moving the source, the maximum increase in the line width is about 5% of the optimum width. Results are presented for the measurement of the gamma-ray energies in ^{182}W and ^{183}W. These energies, which were obtained with a quartz crystal, are generally within 0.02 keV of the quoted uncertainties on the previous measurements which were obtained with germanium crystals. Author (NSA)

N67-26996# IIT Research Inst., Chicago, Ill.
DEVELOPMENT OF NEUTRON SPECTROMETRY FOR CRITICAL ASSEMBLIES Quarterly Report, 20 Jun.–31 Dec. 1966
Robert B. Moler and William E. Zagotta 26 Jan. 1967 37 p
(Contract AT(11-1)-578)
(IITRI-578P31-1; QR-1) CFSTI: HC $3.00/MF $0.65

The development and testing of two neutron spectrometers is discussed. One spectrometer is a proton-recoil proportional counter designed to measure spectra in the energy range from 1 to 500 keV. This spectrometer is expected to exhibit improved resolution at high energies, reduced wall effects and lower gamma sensitivity over conventional proton-recoil spectrometers. The unique feature of this design is a ring of proportional counters in anticoincidence with the wall-less central counter. The other spectrometer is a ^3He sandwich spectrometer designed to measure spectra in the energy range from 100 keV to 14 MeV. This spectrometer is expected to reduce the effect of interfering reactions, to operate in high gamma fields (up to 10^6 R/hr) and to have, at the low neutron energies, improved resolution compared to conventional ^3He sandwich spectrometers. The unique feature of this design is that the ^3He converter gas is used as the filling gas of two identical proportional counters. Author (NSA)

N67-26997# Honeywell, Inc., Minneapolis, Minn.
PRINCIPALS AND PERFORMANCE ANALYSIS OF MULTIPLE RADAR ALTIMETER INSTALLATIONS Final Report
Washington, FAA, Mar. 1967 132 p
(Contract FA-6S-WA-1268)
(RD-67-13)

The critical factors involved in the installation and operation of low range radar altimeters are analyzed with particular emphasis on the reliable and accurate measurement and display of radar altitude, under specified operating conditions. The analysis reflects the limiting factors for optimum operation of both pulse and FM–CW low range altimeters in terms which may be readily inspected and verified on the aircraft. Author

N67-27046# ARO, Inc., Arnold Air Force Station, Tenn.
PERFORMANCE OF A MASS SPECTROMETRIC MODULATED BEAM DETECTOR FOR GAS-SURFACE INTERACTION MEASUREMENTS
J. H. Heald, Jr. Arnold Eng. Develop. Center, Mar. 1967 11 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-35; AD-648984) CFSTI: HC $3.00/MF $0.65

The report describes the performance of an instrument designed to detect molecular flow rates in the presence of the relatively high background gas noise of a space environment chamber. The technique of molecular beam modulation employed consists of three primary elements: (1) the mechanical beam modulator, (2) a quadrupole mass spectrometer, and (3) a lock-in amplifier. Molecular beam intensities of about ten billion molecules/sec-sq.cm are distinguishable from noise at a background pressure of 0.0000002 torr, which corresponds to about one hundred trillion molecules/sec-sq.cm. The detector performance for molecular beams of He, A, N2, and CO2 is reported. This high sensitivity makes possible the use of molecular beam techniques for direct measurements of gas condensation rates. Author (TAB)

N67-27047# Brookhaven National Lab., Upton, N. Y.
STATIC GAS COUNTERS FOR INIMICAL GASES
David R. Christman Nov. 1966 8 p refs
(Contract AT(30-2)-GEN-16)
(BNL-50028) CFSTI: HC $3.00/MF $0.65

Two relatively simple counters for static counting of radioactive gases are described. In one counter the sample gas is contained in a thin-walled glass cylinder which separates it from the counting gas. The outer walls of the counter are made from oxygen-free copper tubing. All-glass counters, which are essentially ordinary internal gas counters, were also constructed. Efficiencies for both counter types are given. NSA

N67-27051# Environmental Science Services Administration, Boulder, Colo. Institutes for Environmental Research.
AN AUTOMATIC SYSTEM FOR THE ANALYSIS OF TIME VARIANT DATA
Paul I. Wells and Donald V. Glen Sep. 1966 88 p refs
(IER-9-ITSA-9; PB-173593) CFSTI: HC $3.00

A data analysis system (Dasy) was developed to analyze data from studies of the behavior of the troposphere, the behavior of radio waves in the troposphere, and the interference environment for the following amplitude characteristics: cumulative amplitude distribution, fade rate versus level, fade duration distribution at specific data levels, and a distribution of the percent of time preset fade durations are exceeded. The system consists of five blocks of transistorized modules, a control chassis, a commutator chassis, a printer, and power supplies. The logic portions of Dasy were designed with transistorized modules to provide greater versatility. Details are given on the circuit logic, printout commutator, length of sample and scan command, buffer amplifiers, and identification code generator. L.E.W.

N67-27053# Centre National de la Recherche Scientifique, Bellevue (France).
MODIFICATIONS FOR THE IMPROVEMENT OF THE CONNES INTERFEROMETER Final Scientific Report, 1 Dec. 1964–1 Sep. 1966
P. Connes 1 Sep. 1966 2 p refs
(Contract AF 61(052)-842)
(AFCRL-66-776; AD-642846) CFSTI: HC $3.00/MF $0.65

Improvements were made until a resolution of 0.08/cm was obtained. TAB

N67-27079# System Development Corp., Falls Church, Va.
RELATIVE EFFECTIVENESS OF DIFFERENT VIEWING DEVICES FOR PHOTO INTERPRETATION
Boyd L. Mathers Nov. 1966 34 p
(Contract DA-49-092-ARO-65)
(TRN-179; AD-647376) CFSTI: HC $3.00/MF $0.65

A study was undertaken to assess the usefulness of different viewing devices—light table and projection—designed to aid interpreters in extracting information from imagery. Particular consideration was given to variations in magnification, scale, and image quality as applied to viewing conditions. Interpreter performance in screening, quick-time, and detailed interpretation tasks was compared by three methods—rear projection (optic), light table, and magnified projection. In a separate experiment, using projection only, interpreter performance on the same three tasks was compared when different levels of image quality, scale, and enlargement were introduced. Significantly better performance resulted under the light table method than the other two methods in quick-time tasks. Imagery of the larger scale yielded significantly better performance on both quick-time and detailed interpretation tasks. Author (TAB)

N67-27087*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ELECTRONIC INSTRUMENTATION
In its Res. Lab. of Electron. 15 Apr. 1967 p 33–37 ref (See N67-27081 14-23)
(Grant NIH FR-07047-01)

Electronic instrumentation for mass spectrography and mass spectrometric detection techniques was developed. Since this instrumentation is environmentally sensitive, a semiclean, temperature- and humidity-controlled shielded room is provided. This environmental control will permit system-produced instabilities to be corrected by sophisticated instrumentation currently developed. A logic diagram depicts the spectrometer focal-plane-to-digital computer—a typical channel of 300–1000 channels. To increase the speed of results from the mass spectrometer, computer processing of data is considered. Ions will be detected by electron multipliers, and the pulses counted and stored for transfer to the computer. R.U.

N67-27108# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
METEOROLOGICAL RESEARCHES, NO. 15
1966 110 p refs In RUSSIAN; ENGLISH summaries
CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. ON SOME RESULTS OF THE COMPARISON OF LONG-WAVE DETECTORS M. A. Sulev p 7–20 refs (See N67-27109 14-14)

2. ON SHORT-PERIODICAL VARIABILITY IN THE READINGS OF THE RADIOMETERS WITH UNPROTECTED SURFACES K. D. Lebedeva, S. I. Sivkov, and T. K. Yastrebova p 21–30 refs (See N67-27110 14-14)

3. ON SOME SOURCES OF ERRORS OF YANISHEVSKY BALANCEMETER N. I. Goysa, T. V. Zhelezniakova, and N. A. Pereliot p 31–43 refs (See N67-27111 14-14)

4. COMPARISON OF LONG-WAVE RADIATION FLUXES MEASURED WITH DIFFERENT INSTRUMENTS Ye. P. Barashkova, K. D. Lebedeva, T. K. Yastrebova p 44–49 refs (See N67-27112 14-14)

5. ON OPERATION OF YANISHEVSKY DOUBLED BALANCEMENTS WITH STABLE FORCED VENTILATION L. Z. Prokh p 50–57 refs (See N67-27113 14-14)

6. EXPERIENCE OF USING FLAT POLYETHYLENE FILMS AS WIND PROTECTION FOR BALANCEMETERS N. I. Goysa p 58–68 refs (See N67-27114 14-14)

7. MODERNIZATION OF YANISHEVSKY BALANCEMETER BY APPLICATION OF MASSIVE RECEPTION PLATES B. A. Aizenshtat p 69–71 (See N67-27115 14-14)

8. SPECTRAL PROPERTIES OF RADIOMETER WITH KRS-5 FILTER Ye. P. Barashkova p 72–79 refs (See N67-27116 14-14)

9. ESTIMATION OF RANDOM ERRORS OF LAIKHTMAN–KUCHEROV NET PYRGEOMETER T. V. Kirillova and S. P. Malevsky–Malevich p 80–82 refs (See N67-27117 14-14)

10. METHODS AND RESULTS OF CALIBRATION OF RADIOMETERS Ye. P. Barashkova, M. A. Vasischeva, and Z. P. Koblova p 83–92 refs (See N67-27118 14-14)

11. ON RELATION OF ASCENDING FLUXES OF LONG-WAVE RADIATION WITH THE SURFACE TEMPERATURE S. P. Malevsky–Malevich p 93–97 refs (See N67-27119 14-14)

N67-27109# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ON SOME RESULTS OF THE COMPARISON OF LONG-WAVE DETECTORS

M. A. Sulev *In its* Meteorol. Res., No. 15 1966 p 7–20 refs (See N67-27108 14-14)

On the basis of data obtained at the time of the All-Union comparison of long-wave detectors the possible sources of errors for several types of instruments are considered. The following types of instruments are examined: detectors with unprotected and unventilated receiving surfaces without compensation, detectors with polyethylene protections from wind, detectors with artificial ventilation, pyrgeometers with compensation, and some other instruments. Author

N67-27110# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ON SHORT-PERIODICAL VARIABILITY IN THE READINGS OF THE RADIOMETERS WITH UNPROTECTED SURFACES

K. D. Lebedeva, S. I. Sivkov, and T. K. Yastrebova *In its* Meteorol. Res., No. 15 1966 p 21–30 refs (See N67-27108 14-14)

Various methods of eliminating short periodical variations due to wind velocity and air temperature changes are discussed. These include protection of sensitive surfaces by polyethylene films or by ventilation, of increasing the lag time of the instrument to an optimal value, and of improving the reading system. It is reported that increasing the lag time from 10 to 15 seconds to about 60 seconds causes a 10-fold decrease in short periodical fluctuation amplitudes. When observations are made with nonmodified instruments, two readings of the index are recommended: maximal and minimal during the time interval of not less than 60 seconds. The average of these two readings with be close to the mean value of the measured net radiation intensity. Author

N67-27111# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ON SOME SOURCES OF ERRORS OF YANISHEVSKY BALANCEMETER

N. I. Goysa, T. V. Zhelezniakova, and N. A. Pereliot *In its* Meteorol. Res., No. 15 1966 p 31–43 refs (See N67-27108 14-14)

Study results indicate that the sources are caused by the instability of outside heat exchange between sensitive surfaces and the surrounding air and the difference in sensitivity of balance meter sides. It is also shown that balance meter sensitivity is practically unaffected by the thermal inhomogeneity of the surrounding air and the turbulent mixing in it. A simple method of tentative graduating of the operating balance meters was worked out based on long wave radiation. An identical balance meter, previously compared with the pyrgeometer, is used as the control instrument. Sensitivity of the balance meter sides also affects the measuring results. Author

N67-27112 Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

COMPARISON OF LONG-WAVE RADIATION FLUXES MEASURED WITH DIFFERENT INSTRUMENTS

Ye. P. Barashkova, K. D. Lebedeva, T. K. Yastrebova *In its* Meteorol. Res., No. 15 1966 p 44–49 refs (See N67-27108 14-14)

A brief description of measuring methods and of the results of comparing the values of the radiation fluxes, which are obtained by five different instruments in various climatic zones are presented. When comparing the results of measuring, the Angstrom's pyrgeometer is chosen as the basic instrument. It is shown that separate long-wave fluxes, measured by radiometers with the filter KRS-5 and with a germanium filter, are in better agreement with the fluxes, measured by the Angstrom's pyrgeometer, than those measured by the Falkenberg pyrgeometer. The long-wave balance, measured by a thermo-electric net pyrradiometer, is systematically underestimated as compared with the long-ware balance measured by the Angstrom's pyrgeometer, which is explained by the fact that the selectivity of the net pyrradiometer is not taken into account in processing of its data. Some causes of divergence in the measurements of long-wave fluxes by different instruments are also analysed. Author

N67-27113# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ON OPERATION OF YANISHEVSKY DOUBLED BALANCEMETERS WITH STABLE FORCED VENTILATION

L. Z. Prokh *In its* Meteorol. Res., No. 15 1966 p 50–57 refs (See N67-27108 14-14)

A double-sided pyrogeometer used for separate radiation flux measurements is described. The instrument consists of two standard balance meters placed one over another with a black body between them. This consists of two thin copper foil plates with a thermoresistance between them in the form of a flat bifilar spiral. Black body temperature is controlled, and all the sensitive surfaces are subjected to forced ventilation at the same rate. Temperature differences inside and outside the balance meters are measured in the pyrgeometer. The advantage of the instrument is its ability to separately measure radiation fluxes relative to the radiation of the same black plate of a certain temperature with stable ventilation of all sensitive surfaces. Author

N67-27114# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

EXPERIENCE OF USING FLAT POLYETHYLENE FILMS AS WIND PROTECTION FOR BALANCEMETERS

N. I. Goysa *In its* Meteorol. Res., No. 15 1966 p 58–68 refs (See N67-27108 14-14)

The paper deals with the question of using flat polyethylene films as wind protection for balancemeters. The processes of photo and thermal ageing of polyethylene do not much influence the coefficient of general weakening of radiation by the filter. The polyethylene selectivity complicates to a considerable extent the conditions of its application. However, these difficulties can be overcome by graduating the instrument in the short- and long-wave spectral ranges as well as by considering some selectivity of polyethylene in the ultraviolet rays. The instruments with flat

polyethylene filters possess highly important sensitivity depending upon the incidence angle of radiation. If with the sun height $h_{\odot}=50°$ the correction factor $E_h=1.02$, then with $h_{\odot}=20°$ $E_h=1.36$, and with $h_{\odot}=10°$ $E_h=2.33$. This leads to the necessity of considerable corrections (more than 20%) for zonal distribution of dissipated and reflected radiation. It is necessary to consider all these corrections in order to provide reliable results. The paper gives values of correlations for different states of sky and various types of underlying surfaces. Author

N67-27115# Academy of Sciences (USSR). Moscow. Soviet Geophysical Committee.

MODERNIZATION OF YANISHEVSKY BALANCEMETER BY APPLICATION OF MASSIVE RECEPTION PLATES

B. A. Alzenshtat *In its* Meteorol. Res., No. 15 1966 p 69–71 (See N67-27108 14-14)

The main advantage of Yanishevsky's thermoelectrical balancemeter is its very little dependence on wind velocity. At the same time the instrument, being not inert enough, is subject to a strong influence of the thermal heterogeneities of the air; this is reflected in considerable instability of its readings in the day-time. In order to reduce this defect it is suggested to increase the mass of the reception surfaces by sticking to them two copper plates 1.0 mm thick with glue BF-2. Due to this alteration, the inertness of the balancemeter is increased to 60 sec., the dependence on the wind velocity insignificantly increases, but the oscillations of the hand of the galvanometer, connected with the balancemeter, decreases by 8–10 times. It has essentially facilitated the observations and has provided a possibility to use the improved balancemeter as a receptor in the course of the radiation balance registration. Author

N67-27116# Academy of Sciences (USSR). Moscow. Soviet Geophysical Committee.

SPECTRAL PROPERTIES OF RADIOMETER WITH KRS-5 FILTER

Ye. P. Barashkova *In its* Meteorol. Res., No. 15 1966 p 72–79 refs (See N67-27108 14-14)

Information is presented on the spectral properties of the reflection coefficient for the receiving radiometer surface, covered with a layer of magnesium oxide mixed with glue BF-6, as well as of the transmission coefficient of filter KRS-5. Basing on this information and on the published data of the spectral distribution of direct and diffuse radiation and that reflected from the underlying surface, the short-wave corrections for the long-wave fluxes measured by radiometer are estimated. When the sky is clear and the receiving surface is shaded from direct rays these corrections for the descending long-wave fluxes reach 1–3% and for the ascending long-wave fluxes—3–10%. When the sky is overcast the correction for the descending long-wave flux can reach 2–17%, for the ascending–1–7%. Author

N67-27117# Academy of Sciences (USSR). Moscow. Soviet Geophysical Committee.

ESTIMATION OF RANDOM ERRORS OF LAIKHTMAN–KUCHEROV NET PYRGEOMETER

T. V. Kirillova and S. P. Malevsky-Malevich *In its* Meteorol. Res., No. 15 1966 p 80–82 refs (See N67-27108 14-14)

The Laikhtman–Kucherov differential net pyrgeometer is an instrument of original construction, the principle of action of which is quite different from most other instruments measuring radiation fluxes. A conclusion is drawn concerning the satisfactory accuracy of measuring the radiation fluxes at night, as well as concerning the low reliability of the data measured during the daytime with the unshaded receiver. The conversion factor obtained by the sun-shadow method is not sufficiently accurate, and it is necessary to calibrate the instrument by other method. When comparing the values of random errors of the differential net pyrgeometer with the errors of some other instruments, it is necessary to take into account the technical capacity of the instrument according to the number of measurements for a certain period of time and to compare random errors of different instruments with reduction to the equal number of readings. Author

N67-27118# Academy of Sciences (USSR). Moscow. Soviet Geophysical Committee.

METHODS AND RESULTS OF CALIBRATION OF RADIOMETERS

Ye. P. Barashkova, M. A. Vasischeva, and Z. P. Koblova *In its* Meteorol. Res., No. 15 1966 p 83–92 refs (See N67-27108 14-14)

Two methods of calibrating radiometers are described. In one, a heated hemispherical radiator is used; the second method is carried out by means of a snow hemisphere using the Falkenberg method. The calibration of instruments by the heated radiator method provides reproducibility of conversion factors to within 0.3%. The conversion factors obtained by the Falkenberg method are on the average 10% higher than those obtained with the heated radiator method. Author

N67-27119# Academy of Sciences (USSR). Moscow. Soviet Geophysical Committee.

ON RELATION OF ASCENDING FLUXES OF LONG-WAVE RADIATION WITH THE SURFACE TEMPERATURE

S. P. Malevsky-Malevich *In its* Meteorol. Res., No. 15 1966 p 93–97 refs (See N67-27108 14-14)

The relationship of the upward flux of radiation to the flux at known surface errors, and errors of surface temperature measurements are considered. Calculation errors, the influence of the air layer, and errors of the mercurial thermometer are discussed. The values of errors caused by the first two factors are given in the form of a diagram dependent on meteorological conditions. A conclusion is drawn that during nighttime the measured radiation flux is always lower than the calculated one, while during daytime it is always greater. Some quantitative characteristics of such differences are noted. R.Li.

N67-27129# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany). Institut fuer Physik der Atmosphere.

A SIMPLE ELECTRONIC INSTRUMENT FOR CONTINUOUS INTEGRATION OF TIME-VARIABLE MEASURING FUNCTIONS [EIN EINFACHES ELEKTRONISCHES GERAET ZUR FORTLAUFENDEN INTEGRATION ZEITLICH VERAENDERLICHER MESSGROESSEN]

Th. Dahlem and D. Paffrath Feb. 1967 18 p refs In GERMAN; ENGLISH summary

(DVL-594; DLR-FB-67-13) CFSTI: HC$3.00/MF$0.65

A simple instrument is described which, during an arbitrary time interval, permits to integrate a measuring function variable with time which is convertible into a proportional d.c. voltage. This voltage is transformed into a proportional sweep frequency by a sweep circuit with glow discharge tube. The saw-tooth oscillations are counted by an electro-magnetic metering relay which gives the result of integration as a number proportional to the integral of the measuring function. The instrument thus has the property of an analog-to-digital converter. Author

N67-27162# Michigan Univ., Ann Arbor. Cooley Electronics Lab.

THE STUDY OF NEW CONCEPTS IN SOLID STATE TRANSDUCERS Final Report, 9 Sep. 1965–31 Aug. 1966

Ralph M. Grant Feb. 1967 63 p refs

(Contract Nonr-1224(60))

(Rept.-7590-F; AD-647957) CFSTI: HC$3.00/MF$0.65

Holographic techniques were shown to be very informative about the steady-state vibrational behavior of transducers. Holograms of objects vibrating underwater were successful; but, more developmental work is needed before high quality results can be obtained. Real time fringes were shown to be very useful in the laboratory for finding transducer resonances (the time average hologram then gives detailed results). They hold promise for studying transient effects. Another promising application of our holographic studies follows directly from the Directionally Sensitive Membrane Employing Optical Diffraction. This would be a stretched membrane or a very thin clamped plate for which real time fringes are produced. Any sound wave striking the plate would disturb the real time fringes. Very minute pressure disturbances could be detected. Author (TAB)

N67-27197# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Inst.

STUDY ABOUT THE USE OF FABRY-PEROT-INTERFEROMETERS FOR THE RESOLUTION OF THE INFRARED WATER VAPOR SPECTRUM IN THE UPPER ATMOSPHERE [STUDIE UEBER DIE VERWENDUNG VON FABRY-PEROT-INTERFEROMETERN ZUR AUFLOESUNG DES INFRAROTEN WASSERDAMPFSPEKTRUMS IN DER HOHEN ATMOSPHAERE]

M. Heidemann Nov. 1966 60 p refs In GERMAN; ENGLISH summary

(BMwF-FB-W-66-02) Available from Zentralstelle fuer Luftfahrtdokumentation und Information (ZLDI), Munich: 12.00 DM

The specifications of a Fabry–Perot Interferometer are discussed which will allow to resolve the infrared water vapor spectrum in the solar radiation from a satellite. For this purpose literature data are used, and compared with values measured at an available instrument for the visible. A resolution of 0.1 cm^{-1} will be possible in the medium infrared if a second interferometer is used as pre-monochromator. Near 50 μ only 1 cm^{-1} resolution can be obtained even if a Cassegrain optic of 10–20 cm diameter is applied. Author

N67-27200# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fur Plasmadynamik.

DESCRIPTION OF TWO NEW PROBES FOR ENTHALPY AND PRESSURE MEASUREMENTS IN HIGH-TEMPERATURE GASES [SONDEN ZUR MESSUNG VON ENTHALPIE UND DRUCK HOCHERHITZTER GASE]

W. Fischer-Schlemm Mar. 1967 53 p refs In GERMAN; ENGLISH summary

(DLR-FB-67-17; DVL-612) CFSTI: HC $3.00/MF $0.65

A new enthalpy probe and a new enthalpy and pressure probe for measurements in high-temperature gases (4.000–15.000°K) are described. A jet, emerging from a plasmagenerator was measured with these probes. Mass and energy ratings were made. Additionally the results were compared with the results obtained from an enthalpy and pressure probe. Author

N67-27204# Joint Publications Research Service, Washington, D. C.

PRODUCTION OF INSTRUMENTS FOR X-RAY SPECTRAL ANALYSIS AND NUCLEAR GEOPHYSICS

Ye. Kramida and Ye. Filippov 4 Apr. 1967 8 p Transl. into ENGLISH from Izv. (Moscow), 2 Mar. 1967 p 5

(JPRS-40524; TT-67-31168) CFSTI: HC $3.00/MF $0.65

The need for increased production of instrumentation and equipment suitable for nuclear geophysical and X-ray spectral analyses is pointed out in two letters to the editor of Izvestiya. In an editorial comment, the complacency of the Ministry charged with administering analytic instrument making is challenged, and the slowness of the State in satisfying the nation's demands for such equipment is critically assessed. M.G.J.

N67-27205 Joint Publications Research Service, Washington, D. C.

SOME RESULTS OF AN INVESTIGATION OF ON-BOARD GRAVIMETERS BY ALL-UNION SCIENTIFIC RESEARCH INSTITUTE FOR GEOPHYSICS

V. O. Bagramyants and A. P. Raynot 7 Apr. 1967 9 p Transl. into ENGLISH from Prik. Geofiz. (Moscow), no. 43 p 83–87

(JPRS-40-556; TT-67-31200) CFSTI: $3.00

To study the problem of the influence of perturbing accelerations on the indications of a marine damped gravimeter, gravimeters installed on a carden joint and a gyro-stabilized platform were placed onboard a hydrographic ship. The simultaneous operation of the devices were observed with unchanged values of the force of gravity and with various degrees of wave action. Results of the marine testing showed: (1) The data produced using the gravimeter on the cardan support base generally correspond to the theory of the influence of perturbing accelerations on the indications of the instrument. The increase in average reading noted with increasing perturbing accelerations is explained by the predominant influence of Brown's correction. (2) During measurements with gravimeters installed on a gyro-stabilized base, the systematic errors did not correlate with the amplitude of the perturbing oscillations. M.G.J.

N67-27215# Wilcox Electric Co., Inc., Kansas City, Mo.

DEVELOPMENT OF FEASIBILITY MODEL AIRBORNE FLIGHT INSPECTION Final Report

Rex A. Darrow Feb. 1967 45 p refs

(Contract FA-65-WA-1328)

(RD-66-99)

The objective was to determine the feasibility of producing an airborne glide slope sensor system which would provide accurate representation of transmitted glide slope signals for flight inspection. The glide slope signal parameters to be evaluated were: radio frequency signal strength, total depth of modulation, and the difference in depth of modulation (DDM) of the two audio tones. Development work took the form of improvements and additions to an existing solid-state glide slope receiver. Two of these units were modified and thoroughly evaluated in a factory test program. Compliance with desired performance was demonstrated in all significant aspects. Results of the flight test indicated quite satisfactory performance. It has therefore been concluded that production of glide slope sensors is feasible assuming certain manufacturing precautions are observed. Author

N67-27230*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CONCEPTUAL DESIGN OF A CALORIMETER FOR GAMMA HEATING MEASUREMENTS IN THE PLUM BROOK REACTOR

Steven R. Borbash and Salvi Altomare Washington, NASA, 1967 24 p refs

(NASA-TM-X-52293) CSCL 18D

A conceptual design of a calorimeter is presented. The system equations are derived and solved. An out-of-pile experiment is proposed to determine the wall heat transfer coefficient and the turbulence factor α, which relates the bulk temperature to the centerline temperature. The calorimeter will be capable of operating continuously over a complete reactor cycle at full reactor power. Author

N67-27234*# Perkin-Elmer Corp., Norwalk, Conn. Optical Group.

APOLLO CO_2 SENSOR Final Report

13 Feb. 1967 26 p refs

(Contract NAS9-2255)

(NASA-CR-65814, ER-8679) CFSTI: HC $3.00/MF $0.65 CSCL 14B

General, optical, and electronics technological details of a carbon dioxide sensor system to be used aboard Apollo spacecraft

for monitoring the partial pressure of the gas in air, are presented. Calibration of the sensor, and normal operation and maintenance of the system are described. A brief history of the project is given. L.S.

N67-27285*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CORONAL PHOTOGRAPHS, ISOPHOTES, AND A FLASH SPECTRUM FROM THE SOLAR ECLIPSE OF MAY 30, 1965

Sheldon M. Smith, Milton E. Henderson, and Ray A. Torrey Washington, NASA, Jun. 1967 42 p refs

(NASA-TN-D-4012) CFSTI: HC $3.00 CSCL 14E

This paper describes the instrumentation used to measure photographically the distribution of coronal brightness from the CV-990 aircraft at an altitude of 38,000 feet during the eclipse of May 30, 1965. The initial data and photographs are presented and the photometric accuracy of the data is analyzed. At the 3–5 arcsec level of spatial resolution, no optical evidence of aircraft boundary-layer turbulence or window deformation was observed. The most difficult problem associated with coronal observation from an aircraft is stabilization of the line of sight for long exposures. The flash spectrum produced accurate positional evidence of 8 prominences on or near the east limb in addition to recording some 50 chromospheric and 2 coronal emission lines. The photometrically uniform south polar corona has been shown to extend to position angles ±55° from the polar axis. Detailed structure of the inner and mid corona is shown on photographs obtained with a radial transmission filter. The manner in which a young center of activity on the solar surface disrupts the form of the quiet corona can be seen in these photographs by comparing the structure over the permanent condensation with that on the opposite limb. Author

N67-27288*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NONMAGNETIC, EXPLOSIVE ACTUATED INDEXING DEVICE

J. P. Bauernschub, Jr. Washington, NASA, Jun. 1967 14 p refs

(NASA-TN-D-3914) CFSTI: HC $3.00 CSCL 22B

A nonmagnetic, explosive-actuated indexing device was developed for a magnetometer experiment flown on the Pioneer VI and VII spacecrafts. Conventional indexing devices were not suitable for use in instruments designed to measure low intensity magnetic fields. This device features an arrangement by which new explosive piston actuators are cycled into position to provide eleven independent operations. The pistons actuate a bistable escapement, which permits precise 180-degree rotation of the magnetometer sensor. Although the device was designed for a specific purpose, it is basically a nonmagnetic stepping motor. It can be modified for other stepping increments, and more operations can be provided. Author

N67-27318*# Parametrics, Inc., Waltham, Mass.

ULTRASONIC TEMPERATURE MEASURING DEVICE

Quarterly Progress Report

L. C. Lynnworth and E. H. Carnevale Apr. 1967 13 p

(Contract NAS3-7981)

(NASA-CR-72242; QPR-7) CSCL 14B

Acoustic tests with the rhenium sensor show that if a metal sheath is to be used to retard carbon penetration into the sensor it is necessary to provide acoustic isolation between the sensor and the sheath. It is found that hafnium oxide and beryllium oxide beading of the sensor is useful if the sensor is left free to expand axially. The tests also show that the bare rhenium sensor can survive in a carbon atmosphere up to temperatures of at least ~4500°R for periods of about one hour despite embrittlement. Acoustic attenuation data were obtained for a number of metals and alloys. The data show that the attenuation varies slightly with temperatures up to some particular temperature and then increases rapidly (approximately exponentially) with temperature above this temperature. The temperature at which this rapid increase in attenuation occurs is highest for tungsten. Tungsten is therefore a favorable choice for at least one of the lead-in wires to be used for future acoustic tests in the WANL oven. Author

N67-27340# Oak Ridge National Lab., Tenn.

MODEL 1232-01 SCINTILLATION DOSIMETER FOR MEASUREMENT OF THE DOSAGE RATE OF X-RADIATION AND GAMMA-RADIATION

M. I. Arsaev, B. F. Osipov, and H. E. Sulimova [1964] 14 p refs Transl. into ENGLISH from Russian

(ORNL-TR-1476) CFSTI: HC $3.00/MF $0.65

The advantages of scintillation dosimeters over ionization for measurements of the dosage rate are examined and a portable dosimeter for measurement of the dosage rate of X- and gamma-radiation in the range of effective quantum energies of 30 to 3000 keV and dosage rates of 0.1 to 300 microroentgens/second is described. In that range of quantum energies, the energy dependence of the dosimeter does not exceed ±15%. The volume of the detector is 37.5 cc. The readings of the dosimeter do not depend on the angle of incidence of the radiation flux in the limits of 0–180° in the working range of energies. The response time for the indications does not exceed 5 seconds in the most sensitive range. The dosimeter is capable of operating in a temperature range of −10° to +40°C and in a humidity of up to 90%. Power is obtained from a 220 volt ac network or from RTs-85kh elements. The service life with a single assembly is not less than 100 hours. It weighs about 2.5 kg. Author (NSA)

N67-27343# Kernforschungszentrum, Karlsruhe (West Germany). Schule fuer Kerntechnik.

THE LARGE-SURFACE PROPORTIONAL COUNTER [DAS GROSSFLAECHENPROPORTIONALZAEHLROHR]

Hans Kiefer Mar. 1966 117 p refs In GERMAN

(KFK-411) CFSTI: HC $3.00/MF $0.65

The development of large surface proportional counters for activity determination of low specific radioactivities, for the energy determination of measured radiation, and for dose determination is outlined. The characteristics and properties of the detectors designed for these purposes are given. The use of large-surface proportional counters in monitoring is discussed. The use of these counters in the continuous measurement of α/β ratios of the radioactivity of air dust, measurement of α-particle x-ray coincidences for specific ^{239}Pu dosimeters, and continuous tritium monitoring in air and water is described. NSA

N67-27426*# National Bureau of Standards, Washington, D. C.

METHODS FOR PERFORMANCE-TESTING OF ELECTRO-MECHANICAL PRESSURE TRANSDUCERS

P. S. Lederer 9 Feb. 1967 37 p refs

(NASA Order R-09-022-043)

(NASA-CR-84445; NBS-TN-411) GPO: HC $0.25; CFSTI: MF $0.65 CSCL 14B

This publication describes methods for the performance-testing of electromechanical pressure transducers (such as telemetering transducers used in aerospace testing.) It covers static and dynamic calibration procedures in detail, delineates environmental and other tests, and describes the test equipment used. Examples of dynamic calibration results are interpreted. Author

N67-27488# Bonn Univ. (West Germany). Institut fuer Strahlen und Kernphysik.

PROBLEMS OF EVALUATION OF DIFFERENTIAL ANGULAR CORRELATION MEASUREMENTS WITH A FOUR-DETECTOR-APPARATUS AND INVESTIGATIONS WITH Yb-172 [AUSWERTEPROBLENE BEI EINER VIER-DETEKTOR-APPARATUR ZUR DIFFERENTIELLEN MESSUNG VON WINKELKORRELATIONEN UND MESSUNGEN AM Yb-172]

H. F. Wagner Nov. 1966 56 p refs In GERMAN; ENGLISH summary
(BMwF-FBK-66-39)

The formulas for the calculation of differential angular correlation measurements are derived and discussed. An application of these formulas to the problems of a four-detector-apparatus is carried out by means of a numerical computer program. The fully transistorized automatic control of this apparatus is described in detail. The measurement of the 203–1095 keV-cascade in Yb 172, carried out with the four-detector-apparatus, is discussed. The results of the measurement are given. Author (NSA)

N67-27549# United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.

AN ANEROID BOMB CALORIMETER FOR MEASURING THE HEAT OF COMBUSTION OF IRRADIATED NUCLEAR GRAPHITE: PRELIMINARY EXPERIMENTS IN AN OBSERVATION BOMB

J. B. Lewis and R. H. Phillips Jul. 1966 28 p refs
(AERE-R-4060) HMSO: 4s

An aneroid bomb calorimeter is described in which the heat of combustion of irradiated graphite can be measured more conveniently and accurately than hitherto. An accuracy of about 1 part in 10,000 is obtainable. Preliminary investigations were carried out in a specially designed observation bomb to determine the best techniques to be used when burning graphite in the aneroid calorimeter. The construction of this bomb, which is fitted with two windows, is described. Experiments showed that a satisfactory determination of the amount of graphite burnt could be obtained from the difference between the original mass and the weight of combustible residue. Author

N67-27567*# Scientific Translation Service, La Canada, Calif.

HALITE THERMOMETER FOR X-RAY INVESTIGATION OF SUBSTANCES IN THE TEMPERATURE INTERVAL FROM 77 TO 1037°K [GALITOVYY TERMOMETR DLYA RENTGENOVSKOFO ISSLEDOVANIYA VESHCHESTV V INTERVALE TEMPERATUR OT 77 DO 1037°K]

V. M. Kozhin Washington, NASA, Jun. 1967 7 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (Moscow), no. 1, 1967 p 185–188
(Contract NASw-1498)
(NASA-TT-F-11002) CFSTI: HC $3.00 CSCL 20M

A method is described in which a crystal or powder of halite (sodium chloride or common salt) serves as the standard determining the temperature of the substance being studied. The dependence of the glancing angle $\theta^{\circ}_{(460)}$ of a NaCl crystal upon temperature is given for Cu–Kα_1–radiation. This is close to a linear dependence in the 77–1037°K range. Employing a table or a graph showing the dependence of the angle $\theta^{\circ}_{(460)}$ on temperature, one may readily determine the temperature of the substance being studied at the point where the X-rays pass through the samples and the standard at the angle $\theta^{\circ}_{(460)}$ measured on a X-ray photograph. Author

N67-27570*# National Aeronautics and Space Administration, Washington, D. C.

DEVELOPMENT AND TESTING OF A HIGH-RESOLUTION PIEZOELECTRIC PRESSURE PROBE [ENTWICKLUNG UND ERPROBUNG EINER HOCHAUFLOSENDEN PIEZOELEKTRISCHEN DRUCKSONDE]

W. Katsaros Jun. 1967 43 p refs Transl. into ENGLISH of the Rept. IPP-1/46 of Institute fur Plasmaphysik G.m.b.H., Garching (West Germany), 1966
(NASA-TT-F-10955; IPP-1/46) CFSTI: $3.00 CSCL 14B

Development of piezoelectric probes for plasma diagnostics, with a resolving power higher by a factor of 3 than conventional probes is described, having the following properties: time resolution about 80 nsec; space resolution, about 0.5 mm; sensitivity, about 5 torr/mv; accuracy, about ±10%. The pressure and density measurements, in an inverse pinch, permitted detailed investigations of shock waves. The quartz pressure guide used for transmission of the pressure pulse to the transducer is described; the pressure pulse variable in amplitude and shape is obtained from a piezoelectric shock generator, excited by a high-voltage pulse, and is used for calibrating the probe. Author

N67-27576*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

METHODS OF DATA REDUCTION FOR THE OPEP AIRGLOW PHOTOMETER ON OGO-II

Jacques Pacquet (Centre Natl. de la Rech. Sci., Verrieres-le-Buisson) May 1967 59 p
(NASA-TM-X-55794; X-613-67-218) CSCL 14B

A brief description is given of the methods used in the reduction of the data from the OPEP airglow photometer on OGO-II. For selected portions of the data, computers have been used to apply instrumental corrections, to reduce an oscillatory component dependent on the position of the OPEP container, and to solve a system of linear equations to compute a vertical emission profile from the observed horizon profiles. Author

N67-27578*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SOME EFFECTS OF MeV ELECTRONS ON THE OGO II (POGO) AIRGLOW PHOTOMETERS

Charles W. Aitken (Vitro Corp. of Am.), Jean Francis Brun (Centre Natl. de la Rech. Sci., Paris), Edith I. Reed, and Walter B. Fowler Mar. 1967 58 p refs
(NASA-TM-X-55791; X-613-67-132) CSCL 14B

After noting the high levels of background current in the Main Body Airglow Photometer on OGO-II, a Polar Orbiting Geophysical Observatory, a series of laboratory tests were made to indicate the sources of interference and methods of prevention. Tests with 2.6 MeV electrons confirmed that such electrons in space could account for the observed signals. Other tests were made which (1) showed that the most sensitive portion of the photometer was the cathode-window combination in the photomultiplier, (2) indicated the effectiveness of various methods of shielding, and (3) studied the presence and decay time of radiation-induced phosphorescence. Further laboratory tests confirmed that a similar OPEP photometer on the same satellite, with a different photomultiplier, a more limited spectral range, and greater shielding, was relatively insensitive to the same environment. Author

N67-27585# California Univ., Livermore. Lawrence Radiation Lab.

RADIOMETRIC CALORIMETRY: A REVIEW, SUPPLEMENT 1

Stuart R. Gunn 15 Jan. 1967 45 p refs
(Contract W-7405-ENG-48)
(UCRL-50173) CFSTI: HC $3.00/MF $0.65

The literature in radiometric calorimetry, primarily of the last three years, is reviewed to supplement an earlier, more comprehensive review and discussion (S. R. Gunn, Nucl. Instr. Methods, 29: 1–24 (1964)). The principal topics are measurements of radionuclides, of photon and particle beam powers, of local absorbed dose, and of nuclear reactor radiations. Some proposed systems and calculations pertinent to particular calorimetric problems are included. Author (NSA)

N67-27586# Union Carbide Nuclear Co., Oak Ridge, Tenn.
AN AUTOMATIC ELECTRODE LOADER AND POSITIONER FOR EMISSION SPECTROGRAPHS
J. D. Caylor 7 Mar. 1967 12 p
(Contract W-7405-ENG-26)
(Y-1589) CFSTI: HC $3.00/MF $0.65

An apparatus has been built that automatically loads counter and crater spectrographic electrodes, positions both to a predetermined analytic gap, and automatically controls the analytic gap during burning. The maximum load of each device is forty samples. Author (NSA)

N67-27593# Brookhaven National Lab., Upton, N. Y.
A DIFFERENTIAL LIQUID CHERENKOV COUNTER WITH CONTINUOUSLY VARIABLE VELOCITY RESPONSE
B. A. Leontic and J. Teiger Dec. 1966 18 p refs
(Contract AT(30-2)-GEN-16)
(BNL-50031(T-447)) CFSTI: HC $3.00/MF $0.65

A differential Cherenkov counter is described in which the velocity band to which the counter is sensitive is changed by altering the relative positions of the optical elements within the counter. The principle of its operation is briefly reviewed, and the design features and performance are discussed in detail. NSA

N67-27607*# National Aeronautics and Space Administration, Washington, D. C.
DEVICE FOR INVESTIGATIONS AT TEMPERATURES FROM 4.2 TO 300°K [USTANOVKA DLYA ISSLEDOVANIY PRI TEMPERATURAKH OT 4.2 DO 300°K]
V. Ye. Danil'chenko, L. F. Kurtenok, L. P. Lubyanov, and V. M. Stolyarov May 1967 6 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 1, 1967 p 208–211
(NASA-TT-F-10988) CSCL 20M

A device is described for optical and electrical studies at low temperatures. The device can be employed to obtain any temperature from 4.2–300°K, and to maintain it with an accuracy which is no worse than 0.001 °K. Author

N67-27633* Chrysler Corp., New Orleans, La. Engineering Dept.
PRESSURE REGULATOR, JOHNSON SERVICE COMPANY PART NUMBER R-970, NASA DRAWING NUMBERS 75M04406 PPR-5 AND 75M04406 PPR-6 Test Report
17 Feb. 1967 72 p
(Contract NAS8-4016)
(NASA-CR-84453; TR-RE-CCSD-1069-3) CSCL 13G

This report presents the results of tests performed on one sample of the pressure regulator. The following tests were performed: (1) receiving inspection, (2) proof pressure, (3) functional, (4) surge, (5) vibration test, (6) operational cycling, and (7) burst. The specimen performance was in accordance with the specification requirements of NASA drawings throughout the test program. It was noted, however, that the specimen dial settings shifted during the vibration and operational cycling tests and that the specimen pressure setting adjustment was very coarse and difficult to set. The pressure regulator structurally withstood all of the test environments. Author

N67-27656*# Air Force Cambridge Research Labs., Bedford, Mass. Terrestrial Sciences Lab.
TERRESTRIAL MULTISPECTRAL PHOTOGRAPHY
J. F. Cronin Jan. 1967 39 p refs *Its* Spec. Rept.-56
(NASA Order R-22-13-012)
(NASA-CR-84495; AFCRL-67-0076) CSCL 14E

Remote multispectral photographic sensing of the earth's surface may be a feasible means of identifying and discriminating between inorganic terrestrial materials differing in composition or physical characteristics. Simultaneous airborne and ground-based photographic and photometric studies of such sites as Mono Craters, California, indicate that within the range of the photographic spectrum (2900 Å to 14000 Å), the most promising region for the geologist and other earth scientists could be the wavelengths outside the visible spectrum. Author

N67-27686 Polish Academy of Sciences, Warsaw.
THE ANALYZER OF THERMOCOUPLE HEATING CURVE TYPE AKNT-1 [ANALIZATOR KRZYWEJ NAGRZEWANIA THERMOPARY TYPU AKNT-1]
Ryszard Andrzejak Mar. 1966 11 p ref In POLISH; ENGLISH summary
(INR-705/III/E)

The analyzer of thermocouple curve is described. The thermocouple is used as a temperature measurement probe. Author

N67-27688 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
A SIX-COMPONENT BALANCE EQUIPPED WITH SEMI-CONDUCTOR STRAIN-GAUGES AND INERTIA-COMPENSATED FOR HOT-SHOT WIND-TUNNELS
Jacques Beaussier [1967] 9 p refs Presented at the 2d Intern. Congr., Stanford, Calif., 29–31 Aug. 1966
(TP-377(1966))

Details are given on the design and construction of a six-component balance for wind-tunnel applications. The balance is equipped with semiconductor strain gauges, which are distributed on two thinned zones whose thicknesses are 0.8 mm. The value of the drag is obtained by a bridge bonded on to the first thin zone whose elastic compression is detected. The rolling moment is obtained by another bridge bonded on to the second zone and detecting the elastic torsion. The advantages and disadvantages of semiconductor strain gauges are pointed out, and the static characteristics of the balance are described. Consideration is given to the dynamic behavior of the balance, including the motion equation, phase–amplitude characteristics, and inertia compensation. The use of the balance in dynamic calibration is also discussed. L.E.W.

N67-27752*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FAST SCAN INFRARED MICROSCOPE FOR IMPROVING MICROELECTRONIC DEVICE RELIABILITY
Leon C. Hamiter, Jr. *In its* Res. Achievements Rev., Vol. II, No. 5 1966 p 1–7 (See N67-27751 14-15)

The emission of infrared radiation by semi-conductor chips led to a method for testing micro-miniature circuits with an infrared microscope. A description of infrared radiation is presented and is related to the electrical power dissipation of an electronic part. A description of the composition and operation of the infrared microscope is presented. The feasibility of inspection of the elements and circuit junctions of microelectronic chips is demonstrated. Thermal maps of circuits are examined for defects and design problems. The possibility of using the infrared microscope for testing transistors is discussed. Author

N67-27754*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AUTOMATED ULTRASONIC SCANNING BY TRIANGULATION METHODS—THE DICKINSON SYSTEM
Robert L. Brown *In its* Res. Achievements Rev., Vol. II, No. 5 1966 p 13–17 (See N67-27751 14-15)

The advantages of ultrasonic testing compared with previous nondestructive test methods are discussed. The capabilities of an acoustic spectrometer are demonstrated in a practical test on a section of S-IC fuel tank. Operation of the acoustic spectrometer by servos rotating the transducers that supply the computer with position information is explained. The location of the transducers, and the computer method of locating flaws in welds through scattered ultrasonic energy are discussed. An accurate method for examining welds and verifying the existence of detected flaws is presented. The system's accuracy and automated operation by remote control are mentioned as ideal qualities for repetitive examination of a ship's hull or a nuclear reactor where severe service conditions exist. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N67-26508*# Southern Research Inst., Birmingham, Ala. Metallurgy Div.
STUDY ON DEVELOPMENT OF SATURN MANUFACTURING TECHNOLOGY FOR WELDING METHODS AND TECHNIQUES TO REDUCE HYDROGEN POROSITY Final Report, 25 Feb.–24 Sep. 1966
A. Clyde Willhelm 28 Oct. 1966 57 p refs
(Contract NAS8-20307)
(NASA-CR-84156; Rept.-8086-1806-VII) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Experiments were performed to determine the feasibility of using various elements to prevent or reduce hydrogen-induced porosity in the inert-gas arc spot welding of aluminum alloys. The experimental welds were made on specimens of 2014-T6 and 2219-T87 aluminum alloy plate of 0.375-in. and 0.312-in. thickness respectively. Experiments were performed with four getter materials (Ti, Zr, Ce, and Ca) chosen as most promising from hydride-forming characteristics. Despite several methods of application of the getters, including mixes with various vehicles as carriers, compaction in small drilled holes, compaction in shallow depressions, compression between halves of butt joints, and deposition and drying (at 400°F) on the surface in slurry form, the results were essentially negative. It was concluded that hydrogen porosity in aluminum welds would not be prevented by the getter technique with conventional welding procedures. There was an indication that some of the getters did attract hydrogen and might have been effective had they not alloyed and carried the hydrogen into the weld nugget. A study of the comparative hydrogen-attracting properties of molten aluminum and prospective getters under expected heat conditions is recommended. Author

N67-26518*# Honeywell, Inc., Minneapolis, Minn. Aerospace Div.
THE DESIGN AND BUILD OF A GAS BEARING GYROSCOPE POSSESSING HIGH "G" AND STERILIZATION CAPABILITY AND UTILIZING A LOW POWER GAS BEARING SPINMOTOR AND HIGH FREQUENCY PUMP Quarterly Progress Report, 3 Jan.–31 Mar. 1967
G. J. Erickson, D. M. Peterson, and R. F. Anderson 31 Mar. 1967 35 p Prepared for JPL
(Contracts NAS7-100; JPL-951559)
(NASA-CR-84146; Rept.-20660-QR1; QPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Details are given on the development of a gas bearing gyroscope possessing high g and sterilization capability and utilizing a low power gas bearing spinmotor and high frequency pump. A spinmotor has been produced to meet the power and sterilization requirements. The high frequency pump implementations has progressed to a dummy gyro assembly. Future work plans are outlined. Author

N67-26560*# Midwest Research Inst., Kansas City, Mo.
HIGH-VELOCITY METALWORKING. A SURVEY
Michael C. Noland, Howard M. Gadberry, John B. Loser, and Eldon C. Sneegas Washington, NASA, 1967 187 p refs
(NASA-SP-5062) GPO: HC $1.25; CFSTI: MF $0.65 CSCL 13H

Comparative data are presented on the deformation velocities in high velocity and conventional metalworking processes. These show that, in explosive, electrohydraulic, and electromagnetic techniques, the deformation velocity range is at least one order of magnitude higher than the ranges of conventional methods. Although there is some overlap for pneumatic-mechanical systems, metallurgical effects appear in work done by this method which are not apparent in conventionally processed parts. Details are given on how these four techniques work, and the equipment and applications to metalworking problems are described. In discussing die and tooling design, attention is centered on high velocity sheet metal forming dies, and high velocity forging dies. Metal behavior in sheet and plate forming is assessed. Also included is a review of present trends and future prospects for extending the capabilities of the processes. M.G.J.

N67-26589*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
HYDRODYNAMIC JOURNAL BEARING PROGRAM Quarterly Progress Report, Jul. 29–Oct. 29, 1966
H. E. Nichols, W. D. C. Richards, R. J. Rossbach, and W. H. Bennethum 29 Oct. 1966 153 p ref
(Contract NAS3-6479)
(NASA-CR-72175; QPR-6)

In the continuing development of journal bearings for space use, the test rig was installed into its facility, and subsequent rig checkout testing was conducted using the two axial groove cylindrical bearings. The test rig was successfully run to a maximum speed of 17,450 rpm before termination. Instrumentation details are also given in reference to the displacement measuring system, the installation configuration, and the calibration procedures and apparatus. Summary data are presented on the calibrations conducted on the individual probes to determine the scale factor potentiometer at 77°F settings, and for individual probes and pairs of summed probes at nominal temperatures of 75° and 120°F. The effect of water on displacement measurements is assessed, and measurement accuracy is discussed in relation to estimating probable errors in equilibrium and dynamic displacement. Force cell calibration and switching and signal conditioning are also considered. Procedures for aligning the bearing stability test rig using optical tooling are outlined, and a start up check list is included. M.G.J.

N67-26607# Illinois Univ., Urbana. Coll. of Engineering.
GENERAL ENGINEERING
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 111–116 refs (See N67-26601 14-30)

General engineering summary studies are presented for such diverse subjects as production scheduling, weather modification, new construction materials, cantilever deformations, study of spacial

perception, environmental radioactivity, and curriculum development for the education of engineering technology teachers. R.Li.

N67-26608# Illinois Univ., Urbana. Coll. of Engineering.
MECHANICAL AND INDUSTRIAL ENGINEERING
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 117–131 refs
(See N67-26601 14-34)

Mechanical and industrial research work is summarized for programs in heat transfer, gas dynamics, thermodynamics and transport phenomena, metal cutting, heating and air conditioning, internal combustion engines, machine design, industrial engineering, and human factors in physical environment. New technical facilities developed are: a low-density, hypervelocity, continuous-flow wind tunnel, an additional water table, a 200-lb. electric induction melting furnace, a passive analog containing 60 nodes for heat transfer studies, and a dynamic fatigue testing machine. R.Li.

N67-26636*# General Electric Co., Philadelphia, Pa.
ELECTROFORMING ALUMINUM COMPOSITES FOR SOLAR ENERGY CONCENTRATORS Final Report
A. G. Buschow, I. J. Hess, and F. J. Schmidt 19 May 1967 73 p refs
(Contract NAS1-5743)
(NASA-CR-66322) CSCL 13H

Descriptions are given of the tests, experiments, developments, and studies relating to the optimization of an aluminum electrodeposition process. Included are the efforts towards increasing the strength of the aluminum deposits by codeposition of glass fibers and hollow silica microspheres, as well as a preliminary design of a plating cell, scaled up by a factor of 15, which would be suitable for electroforming up to 10-ft diameter solar concentrators. Significant increases in electroform strength were achieved. The ultimate tensile strength and yield point at 0.2% offset were increased by 87% and 115%, respectively, for glass fiber–aluminum composites vs plain electroformed aluminum. The laboratory reinforcing process was successfully transplanted into the 200 gallon pilot cell. The pilot cell built previously was modified to improve operation and to evaluate potential scale up procedures and designs. A number of 30-in. solar concentrators were electroformed in the modified pilot cell. These included glass fiber and silica microsphere codeposition runs. Author

N67-26713# Frankford Arsenal, Philadelphia, Pa. Pitman–Dunn Research Labs.
TORQUE TEST FOR EVALUATING THE QUALITY OF ALUMINUM ALLOY MELTS
Harry V. Sulinski and Samuel Lipson Dec. 1966 40 p refs
(R-1833; AD-648486) CFSTI: HC $3.00/MF $0.65

A preliminary development of a cast torque specimen has been made for evaluating the quality of an aluminum alloy. The approach was to design the specimen, develop a testing procedure, and correlate the test results with those obtained with companion, separately cast-to-size, tensile bar specimens. The developed torque specimen was cast to size using a resin-bonded shell mold, and tested using an indicating torque wrench. It was found that the torque data reproducibility is equivalent to the reproducibility observed for separately cast tensile bars. In general, heat-treated (T6) torque and tensile specimens reflect artificially produced variations in the gas and magnesium contents of A356 alloy. As-cast specimens of A356 alloy are relatively insensitive to these variations in melt quality. It was recommended that further work be conducted to: (1) monitor heat treatment of aluminum castings; (2) improve the sensitivity of the test to permit melt quality evaluation on the basis of as-cast test specimens. TAB

N67-26759# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT OF PRACTICE FOR COMPOSITE ROLLING OF STRUCTURAL METAL PANELS Quarterly Progress Report, 15 Aug.–15 Nov. 1966
K. R. Grube, D. N. Williams, and E. S. Bartlett Nov. 1966 28 p
(Contract DA-19-066-AMC-308(X))
(AMRA-CR-66-02/3; QR-4; AD-648304) CFSTI: HC $3.00/MF $0.65

The use of titanium-deoxidized steel for support material was found to be beneficial in the successful bending of composite-rolled structural panels of Inconel, PH14-8Mo, Ti-4Al-0.2 O2 and Ti-8Mo-8V-2Fe-3Al. High-strength skin-to-rib bonds were obtained in panels from small packs rolled in the laboratory. Author (TAB)

N67-26784# Sumitoto Electric Industries, Ltd., (Japan).
NEW COATING PROCESS FOR FOAMED POLYETHYLENE INSULATED TELEPHONE CABLE
M. Sugi, C. Kawazoe, T. Ichiba, T. Suzuki, H. Shinba et al Dec. 1966 6 p Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966
(AD-646542) CFSTI: HC $3.00/MF $0.65

This article describes a newly developed high speed coating process for producing foamed high density polyethylene insulated fine gage conductors for use in exchange cables. Author (TAB)

N67-26802# Eaton Yale and Towne Inc., Kenosha, Wis.
A TANDEM WIRE DRAWING AND INSULATING LINE
C. R. Bauer and B. Batenburg [1966] 6 p refs Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966 Prepared jointly with Western Elec. Co., Inc.
(AD-646546) CFSTI: HC $3.00/MF $0.65

The payer describes the operation of the tandem wire drawing and insulating line, to the extent of what takes place between the supply reel of bare conductor and the high speed take-ups containing the finished product. This is only one of the major steps required in the manufacturing process of PIC cable. This step, along with the entire PIC manufacturing facilities, provides reliable PIC cable for use in communications. TAB

N67-26834# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
LOW-ENERGY ACCELERATED ION DEPOSITION
G. E. Baum 6 Feb. 1967 11 p refs
(Contract AT(29-1)-1106)
(RFP-686) CFSTI: HC $3.00/MF $0.65

A low energy accelerated ion vapor deposition technique is described which provides superior film adherence when compared to the more common vapor deposition techniques. The significant feature is the ionization of the depositing species by an electron reinforced gas discharge and subsequent acceleration into a substrate held at a low negative potential. In addition to good film adherence, this technique provides a low sputtering rate and only moderate substrate heating. Author (NSA)

N67-26836# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
CLEANING AN IDEAL BERYLLIUM SURFACE
R. O. Adams 14 Feb. 1967 14 p refs
(Contract AT(29-1)-1106)
(RFP-879) CFSTI: HC $3.00/MF $0.65

A (0001) plane of a Be single crystal is arbitrarily defined as an ideal Be surface. Requirements for cleaning this surface were established. It was found necessary to heat the crystal to 1000°C to produce a clean surface. Sputtering for 30 minutes, with 1000 eV argon ions, also cleaned the surface as well as the 1000°C heating did. Author (NSA)

N67-26903# International Business Machines Corp., Owego, N. Y. Electronics Systems Center.
CONSTRUCTION OF VACUUM-FORMED CONTROL AND DISPLAY MOCKUP PANELS Final Report, Mar.–Jul. 1966
Claude V. Deats and Gunnar Nielsen Wright-Patterson AFB, Ohio, AMRL, Nov. 1966 53 p
(Contract AF 33(615)-3739)
(AMRL-TR-66-175; AD-648519) CFSTI: HC $3.00/MF $0.65

The report describes a process for vacuum-forming thin sheets of plastic material into control and display panel mockups. The description includes techniques for fabricating controls and annunciators plus requirements for drawings, tools, equipment, and materials. The vacuum-forming process, which is well established in the plastics industry for fabricating parts in large quantities, is fast and inexpensive. In this report, the fabrication of a typical mock-up panel is used to illustrate the vacuum-forming process. Author (TAB)

N67-26940# Franklin Inst., Philadelphia, Pa. Research Labs.
COLD WELDING OF COPPER UNDER ULTRAHIGH VACUUM Semiannual Report, Oct. 1, 1966–Mar. 31, 1967
H. Conrad and L. Rice 31 Mar. 1967 45 p refs
(Contract Nonr-4825(00))
(SA-B2368-4; AD-648744) CFSTI: HC $3.00/MF $0.65

The cohesion of copper under ultrahigh vacuum in the range 10 to the minus 11th power to 10 to the minus 9th power torr was investigated using the technique of cold welding specimens previously fractured in the vacuum. It was found that the cohesion coefficient increased with the compressive load during cold welding but was relatively independent of the purity and structure of the copper (and in turn the hardness and strength), time of contact over the range 5 sec to 900 sec and exposure to the vacuum environment over the range of 10 to the minus 9th power to 0.0001 torr-sec. No voids were detected at magnifications up to 1000X along the weld interface of fine-grained (6 - 10 microns) specimens which had been cold welded at loads approaching the virgin fracture load. Voids were, however, observed for coarse-grained (100 - 450 microns) specimens at such loads and for all specimens at loads appreciably below the initial fracture load. From ultrasonic transmission studies it was deduced that the cohesive strength was proportional to the area of contact developed during cold welding. The effect of compressive load on the cohesive strength is explained by the increase in contact area resulting from elastic and plastic strains in the vicinity of the interface. This interpretation suggests that the cohesion coefficient should be proportional to the reciprocal of the elastic modulus, which was shown to be the case when comparing Cu, Ag and Fe. The fact that the cohesion coefficient was independent of exposure to the vacuum environment up to 0.0001 torr-sec is shown to be in accord with adsorption theories. Author (TAB)

N67-26949# Army Materials Research Agency, Watertown, Mass. Materials Testing Lab.
A REPORT GUIDE TO ULTRASONIC TESTING LITERATURE, VOLUME III
Charles P. Merhib and Ernest H. Rodgers Dec. 1966 85 p refs
(AMRA-MS-66-11, Vol. III; AD-648905) CFSTI: HC $3.00/MF $0.65

The main objective of this compilation is to provide a simple and fast access to information on the subject of ultrasonic testing and also to provide sufficient information in the form of abstracts and word descriptors to make the listing useful. Author (TAB)

N67-26975# ManLabs, Inc., Cambridge, Mass.
FUNDAMENTAL STUDY OF THE SINTERING KINETICS OF REFRACTORY COMPOUND PHASES AT HIGH PRESSURE AND HIGH TEMPERATURE Summary Report, 1 Oct. 1965–30 Sep. 1966
David Kalish and Edward V. Clougherty Oct. 1966 32 p refs
(Contract Nonr-4262(00))
(AD-648970) CFSTI: HC $3.00/MF $0.65

The work was divided between two aspects of high pressure hot pressing. The first phase involved a study of the problems associated with fabricating crack free compacts of TiB2 by high pressure hot pressing. In addition, the bend strength and fracture mode of high pressure hot pressed TiB2 and conventionally hot pressed TiB2 were determined as a function of test temperature up to 1400C. The second phase of the program was concerned with the mechanism of densification of hafnium diboride in high pressure hot pressing. Densification studies for conventional hot pressing were reviewed and the results correlated with the hafnium diboride work. The final stage of densification was analyzed in terms of the Nabarro-Herring flow model. The principal variable studied was the fabrication temperature, although some attention was given to the fabrication time and pressure. Author (TAB)

N67-27123 Institute de Soudure, Paris (France).
EXPERIMENTAL CONTRIBUTION OF THE METALLURGICAL STUDY OF THE GAS-CUTTING AND THE J-GROOVING WITH AN OXYACETYLENE BLOWPIPE [CONTRIBUTION EXPERIMENTALE A L'ETUDE METALLURGIQUE DE L'OXY-COUPAGE ET DU CHANFREINAGE EN J AU CHALUMEAU OXYACETYLENIQUE]
H. Granjon and R. Gaillard Brussels, EURATOM, Mar. 1967 35 p In FRENCH; ENGLISH summary
(Contract EURATOM-007-64-7 TEEF)
(EUR-2849.f)

The metallographic and thermal study of gas-cutting and grooving with an oxyacetylene blowpipe, yielded the following conclusions: (1) the maximum temperatures reached in the parent metal come very close to the melting point; (2) fusion was detected by micrographic examination, at least in the case of the grooving process; (3) at the point where it impinges on the metal, the oxygen jet has a cooling effect which supplements that of the thermal conductivity; (4) the cooling rate near the cuttings drops when the cutting thickness increases; (5) any steel for welding can be prepared by gas-cutting; moreover, preheating affords, if necessary, an additional safety margin; (6) J- or double-J grooving on thick plates, a process which becomes all the more economic with increasing thickness, is particularly appropriate for prewelding preparation; and (7) the probe technique, which has been the key factor in this thermal and metallographical investigation, enables other applications to be carried out. Author

N67-27127# College of Aeronautics, Cranfield (England).
AN INVESTIGATION INTO THE FATIGUE PROPERTIES OF A SINGLE SPOT WELD LAP JOINT
A. Younger, L. M. Gourd, and J. E. M. Jubb Mar. 1966 26 p refs
(CoA-MAT-1) CFSTI: HC $3.00/MF $0.65

An investigation has been made of the behavior, under fatigue loading, of resistance spot welds in mild steel sheet. A single spot weld lap test piece has been used and all the spot welds have been produced under the same conditions. The specimens have been subjected to static tensile loads of 220, 330 and 440 lb., on to which have been superimposed alternating loads having amplitudes ranging from ±50 to ±440 lb., chosen so that the specimens have been in tension at all times. In this work the most important parameter in determining the fatigue life appears to be the amplitude of the alternating load. Failure is initiated at the junction of the weld nugget and the interface between the sheets, and cracks propagate around the periphery of the weld identation. It is suggested that the effect of the size of spot, sheet separation and identation depth should be investigated to confirm the trends observed in this work. Author

N67-27209# General Dynamics/Convair, San Diego, Calif.
ELECTRON BEAM WELDING OF FOUR STRUCTURAL ALLOYS
W. A. Roden Dec. 1966 51 p
(GDC-ERR-AN-955)

Electron beam (EB) welding schedules were established, and the characteristics and properties of typical EB welds were determined for four structural materials. Several thicknesses and joint designs were used and weld property data were obtained on all weld specimens. Tensile strengths and bend test evaluations were

made and all specimens were X-ray radiographed. A macrograph specimen was made of each type material and thickness and examined for internal defects. Basic tooling requirements were established during set-up and welding technique development. These requirements can be applied to the planning and design of EB welding fixtures for production parts. A cost comparision was made for EB welding versus another process such as TIG welding. It was concluded that EB welding is generally less costly, and the high welding speeds, simplified tooling, and high reliability make it a highly efficient process for production welding. Author

N67-27210# General Dynamics/Convair, San Diego, Calif.
DEVELOPMENT OF MANUFACTURING METHODS FOR FABRICATING AND APPLYING A NEW SUPERINSULATION MATERIAL
D. J. Gorham Dec. 1966 19 p refs
(GDC-ERR-AN-960)

Efforts to achieve a manufacturing capability for superinsulation materials are discussed. Designed for use with liquid hydrogen propellant tanks and space vehicle structures, the proprietary material consists of a thin, 1/4 mil Mylar film, aluminized on both sides, and with a discrete pattern of nylon filament flocking applied to its surface. The flock provides separation between layers, suppressing solid conduction of the cold wall; its reflectivity suppresses radiant heat transfer. Assembly and installation methods for applying the superinsulation onto test hardware are also discussed. M.G.J.

N67-27216# General Dynamics/Convair, San Diego, Calif.
PERMANENT JOINING OF STAINLESS STEEL TUBING BY AUTOMATIC FUSION WELDING
R. G. Baumann Dec. 1966 32 p
(GDC-ERR-AN-956)

The objective was to develop methods for joining stainless steel tubing in confined areas by automatic TIG fusion welding. Two different weld joints were investigated: a double standing flange joint, and a sleeved joint. Specimens of 0.5 inch and 1.0 inch diameter stainless steel tubing were fabricated using each of the two joint geometries. The specimens were then subjected to pressure and fatigue testing at three stress levels and joint efficiencies compared. It is concluded that miniaturized automatic TIG welding equipment is available and suitable for production use in joining stainless steel tubing in diameters from 1/4 inch through four inches. It is recommended that permanent tube joining be considered in lieu of mechanical fittings where leakage, weight, and maintenance are problems. Author

N67-27218# General Dynamics/Convair, San Diego, Calif.
PLANNING GUIDE FOR TITANIUM FORMING
G. I. Baxter Dec. 1966 81 p
(GDC-ERR-AN-957)

A guide is presented for design engineers, tool planners, and estimators concerned with forming airframe parts made of annealed titanium alloys. It provides methods, tooling and cost data to permit comparative analysis. Typical parts are illustrated and alternate manufacturing methods analyzed for each part, and problem areas are highlighted. Cost data sheets are provided for typical titanium parts. These sheets permit comparing one forming method to another by listing sequence of operations, set-up and run times, and tooling cost estimates. Typical parts included are skins, stiffeners, stringers, frame sections, gussets, brackets, and integrally stiffened panels. Forming methods described include pyramid or slip rolling, stretch forming, brake bending, wipe forming, creep forming, and hot forming. Author

N67-27219# General Dynamics/Convair, San Diego, Calif.
PLASMA ARC WELDING COMPLEX TITANIUM JOINTS
G. J. Langford Dec. 1966 47 p refs
(GDC-ERR-AN-953)

The capability of plasma arc welding was extended to include tapered joints, welding from opposite side, multipass from one side, and T joints by the burn-down and burn-through techniques. A Ti–6Al–4V alloy was used, and welded in the mill-annealed condition. Destructive evaluation, involving tensile, bend, and metallographic tests, revealed high strength joints with useful ductility. Metallographic examination showed that adequate interpenetration was accomplished where more than one weld pass was required. It was concluded that the penetration and welding speed advantages of plasma welding over conventional methods, such as TIG, permit simpler holddown and joint alignment tooling because distortion tendencies are less. M.G.J.

N67-27220# General Dynamics/Convair, San Diego, Calif.
SOLID STATE WELDING SYSTEM TECHNICAL DATA DEVELOPMENT
Eugene D. Green Dec. 1966 24 p
(GDC-ERR-AN-954)

Experiments, using titanium alloy 6Al–4V, were conducted and technical data developed which established criteria for solid state welding fabrication techniques and processes, unique to the solid state welding system. Using these techniques and processes, hardware and test specimens were fabricated. Test results revealed excellent mechanical and metallurgical joint properties were obtained. Properties equal to the base material (100% joint efficiency) were achieved. Hardware produced, and data developed, further demonstrated and emphasized the potential of the solid state welding system for fabricating large and small structural components, under controlled conditions with a high degree of reliability. Author

N67-27257 Hawker Siddeley Aviation, Ltd., London (England).
STRETCH FORMING OF VERY LONG STAINLESS STEEL SKINS
W. Padley and J. Fray London, Min. of Aviation, Feb. 1967 21 p
(Contract KS/1/0135/CB.43(A)(2))
(S&T-MEMO-1/67) CFSTI: $3.00

Precipitation hardening FV520 stainless steel was stretch formed in the fully softened (austenitic) and the cold rolled and transformed (martensitic) conditions using the H.S.A. 250T stretching machine; the skins were subjected to various heat treatments after forming. It was shown that FV520 skins up to at least 45 ft. long can be stretch formed satisfactorily in the soft condition only. Forming in the harder condition gave rise to considerable springback. Long skins of FV520 could be heat treated satisfactorily after stretch forming, but low temperature transformation was impractical due to problems of distortion. Author

N67-27319*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
IMPORTANCE IN LUBRICATION OF VARIOUS INTERFACE TYPES FORMED DURING VACUUM DEPOSITION OF THIN METALLIC FILMS
T. Spalvins and D. H. Buckley Washington, NASA, 1967 18 p refs Presented at the 10th Vacuum Metal. Conf., New York, 13–15 Jun. 1967
(NASA-TM-X-52305) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Various vacuum deposition methods are used to deposit soft, thin metal gold films on metal surfaces for lubrication purposes. When a metal film is deposited on a surface, the adhesion characteristics of the deposited metal film to the substrate depend on the type and structure of the interfacial region. This interfacial region is directly related to the solid solubility and alloying concepts. The type or nature of the interface directly influences the endurance and strength properties of a lubricating film. Three vacuum deposition methods were used here: (1) vapor deposition, (2) sputtering, and (3) ion plating. The characteristics of the film and interface were examined in friction experiments in ultra high

vacuum. The coefficient of friction was used to determine the strength and durability of the deposited film. Depending on the vacuum deposition method and the selection of film and substrate material, five types of interfaces can be distinguished. The diffusion and high energy embedded interfaces are desirable because a graded, layer-like interface is formed. Author

N67-27329# Utah Univ., Salt Lake City. Inst. of Materials Research.
IMPURITY EFFECTS ON THE CREEP OF POLYCRYSTALLINE MAGNESIUM AND ALUMINUM OXIDES AT ELEVATED TEMPERATURES Technical Progress Report, 1 Apr.–23 Dec. 1966
Ronald S. Gordon 23 Dec. 1966 29 p refs
(Contract AT(11-1)-1591)
(COO-1591-1) CFSTI: HC$3.00/MF$0.65

The design and construction of a vacuum hot-press and two high temperature creep testing facilities are described. Initial exploratory experiments have been conducted on the hot-pressing of pure and doped (Fe_2O_3) MgO and the creep of pure dense (or nearly dense) hot-pressed MgO. Pure and doped (Fe_2O_3) MgO specimens have been hot-pressed to theoretical density at pressures between 20,000 and 35,000 psi, and temperatures between 1040 and 1260°C. Preliminary results from the hot-pressing and creep of dense (or nearly dense) hot-pressed MgO indicate that grain growth can take place in significant amounts below 1300°C. An analysis into the role of a changing microstructure (grain growth) on the creep process in MgO is being undertaken. In addition, the effect of a small amount of porosity on grain growth during creep is being studied. Author (NSA)

N67-27330# Minnesota Mining and Mfg. Co., St. Paul, Minn.
FABRICATION OF TUNGSTEN ALLOY TUBING, 1 JULY 1965–14 JUNE 1966
H. G. Snowman, A. Milner, and D. Rowenhorst 23 Dec. 1966 24 p
(Contract AT(11-1)-1518)
(COO-1518-4) CFSTI: HC$3.00/MF$0.65

A 3M-developed powder metallurgical fabrication process was adapted to the manufacture of small diameter tubing in W–26 at. % Re and W–30 at. % Mo–30 at. % Re alloys having useful engineering properties. Results show that good quality tubing was produced which was ductile at room temperature in the as-sintered condition, and capable of being successfully processed by both plug and mandrel drawing. Author (NSA)

N67-27331# Bettis Atomic Power Lab., Pittsburgh, Pa.
PROPERTIES OF ZIRCALOY-4 TUBING
C. R. Woods, ed. Dec. 1966 235 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-585) CFSTI: HC$3.00/MF$0.65

In order to obtain design information of Zircaloy-4 tubing, an extensive test program was carried out which included as materials variables the fabrication method, grain size, and cold-work, and as test variables temperature and time. The tests included conventional longitudinal tensile tests as well as internal and external pressure tests to more nearly simulate service loading conditions, biaxial tests to determine the degree of anisotropy present, and ring tests to obtain transverse properties. Physical properties investigated included corrosion rates (and concomitant hydrogen pickup), crystallographic texture, hydride distribution, and annealing kinetics. Results include the following: a determination of the effect of texture on hydride orientation and on the variation of yield strength with loading condition, proof that the improvement in properties conferred by cold-work is not retained under low stress creep conditions, and proof that cold-work hardening and irradiation hardening are not additive in all cases. Author (NSA)

N67-27364*# Boeing Co., Seattle, Wash. Launch Systems Branch.
ANALYSIS OF FAILURE OF SHAFT FROM THE LOX INTER CONNECT VALVE, 60B41005-1
R. R. Sands [1967] 10 p
(Contract NAS8-5606)
(NASA-CR-84405; T2-6539-86) CFSTI: HC$3.00 CSCL 13K

The valve had been operated approximately 100 times before it became inoperative and was the second failure of this type. Failure was attributed to fatigue of surface structure embrittled by grinding practice. Author

N67-27371*# Boeing Co., Seattle, Wash. Space Div.
IDENTIFYING OPTIMUM PARAMETERS OF HOT EXTRUSIONS
R. W. Rice and J. G. Hunt May 1967 209 p refs Prepared jointly with Nucl. Metals, Inc.
(Contract NAS7-276)
(NASA-CR-84412; IR-3) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The purpose of this program is to develop a technique for hot extruding MgO and to determine the effect of such extrusion on MgO. Considerable versatility in extruding ceramic shapes was demonstrated by the successful extrusion of square billets (in a round can) through a round die; round billets (in a round can) through a square die; billets side-by-side and off-set from the can axis; and of an insulating can (alternate metal and ceramic layers) with a ceramic core. Extrusion of different shapes did not change the ⟨100⟩ axial texture, nor did different starting billet textures (oriented single crystals). Feasibility of extruding crack-free MgO bodies was confirmed by repeated extrusions of billets to crack-free rods of 0.4 inch diameter or less. Cracking in larger bodies was also reduced by use of a heated catch tube and the insulating can concept, with the latter indicated as the most successful method of reducing longitudinal cracking. The insulating can concept shows promise in lowering initial heating to reduce extruded grain size, and hence increase strengths. Much of the reduction in strength of as-extruded specimens tested chemically polished is eliminated with annealing to about 2200°F(1205°C) or more. Since this annealing is the same as required to eliminate residual stress, a stress corrosion mechanism is suggested. Author

N67-27397 Joint Publications Research Service, Washington, D. C.
MEASURES FOR PROVIDING SAFE WORKING CONDITIONS DURING CAISSON OPERATIONS DESCRIBED
N. N. Schupakov 24 Feb. 1967 70 p Transl. into ENGLISH from the book "Okhrana Truda pri Kessonnykh Rabotakh", Moscow, 1957 p 38–66, 77–118, 126–133, 136–137
(JPRS-40018; TT-67-30665) CFSTI: $3.00

The caisson chambers are supplied with compressed air by compressor stations that form an integral part of the caisson equipment. General information pertaining to the layout of the stations and their equipment, their costs, and operations is given. The removal of lubricating oil from the air pumped into the caisson; the effects of increased atmospheric pressure on the human organism; preventative measures against the diseases contracted while working in the caisson; and general measures for protecting individuals involved in caisson operations, are discussed. L.S.

N67-27429*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
NONDESTRUCTIVE TESTING FOR SPACE APPLICATION, FEASIBILITY AND PRELIMINARY DESIGN STUDY Phase I Report, July–September 1966
W. A. Zoran 15 Oct. 1966 132 p refs
(Contract NAS8-20630)
(NASA-CR-84442) CSCL 13H

The need for development of nondestructive testing technology for in-space use is clearly defined by a thorough examination of current and proposed future space programs. Its use, and selection of the best methods of inspection considering ultrasonics, eddy current, and radiography are also discussed. These are related to proposed in-space fabrication, repair, and other functional requirements such as medical, preventative maintenance, and scientific research aid. A preliminary design concept of an integrated ultrasonic-eddy current instrument with a detachable radiography unit is presented. Results of this study phase have indicated this prototype breadboard hardware, utilizing "off-the-shelf" equipment to be only the first step in what must be a parallel effort to other in-space fabrication studies and developments. The space environments compatibility and the required human engineering aspects are defined with a test plan for their evaluation. The demonstration test for the prototype unit is outlined, based upon use of a test subject suited in an NASA owned Apollo Block II suit in the 8 foot environmental chamber at NASA–MSC. Author

N67-27501*# Boeing Co., Seattle, Wash. Launch Systems Branch.
TEST OF BACN10EL NUTPLATE
J. F. Hart 30 Dec. 1966 7 p
(Contract NAS8-5608)
(NASA-CR-84462; T5-6539-84) CFSTI: HC $3.00/MF $0.65 CSCL 13E

Procedure and results are presented of a test which was conducted to compare the properties of the BACN10EL nutplate to the requirements of the BAC standard page and the procurement specifications MIL-N-25027. The nutplates were tested for dimensional compliance, threads, locking and breakaway torque, torque out, push out, and axial tensile strength. The results are tabulated and show that the standard is acceptable for use on the Saturn S-IC. R.N.A.

N67-27503*# Chrysler Corp., New Orleans, La. Space Div.
CHECK VALVE, 3/8-INCH JAMES, POND, AND CLARK, INC., PART NUMBER P12-698 Test Report
B. J. Coccaro 28 Nov. 1966 40 p
(Contract NAS8-4016)
(NASA-CR-84468; TR-RE-CCSD-FO-1007-3) CSCL 13K

The results are presented of tests performed on three specimens of Check Valve 75M51313-2. The following tests were performed: receiving inspection, functional, low temperature, high temperature, flow, and surge. Failures of the test specimens precluded the performance of vibration, sand and dust, salt fog, life cycle, and burst tests. One specimen failed mechanically during low temperature, and two specimens failed during surge testing. Only one specimen passed all tests. Author

N67-27508*# Boeing Co., Seattle, Wash. Launch Systems Branch.
EVALUATION OF MACHINE SEWN JOINTS FOR THE FLEXIBLE HEAT SHIELD CURTAIN
John N. Dexter 30 Dec. 1966 10 p
(Contract NAS8-5608)
(NASA-CR-84474; T5-6556-10) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Joints in the wire reinforced asbestos and silica cloth plies of the 60B20508 flexible flame curtain assembly are currently being made by hand sewing. This investigation covers results of attempts to machine sew these joints. Results indicate that acceptable joints can be machine sewn in the silica cloth ply. Machine sewing was unsuccessful for the asbestos ply. Author

N67-27509*# Boeing Co., Seattle, Wash. Launch Systems Branch.
METALLURGICAL ANALYSIS OF FILTER HOUSING ASSEMBLY 60B83104-1, SERIAL NUMBER 69 FAILURE
C. B. Schwartz 12 Sep. 1966 20 p refs
(Contract NAS8-5608)
(NASA-CR-84475; T5-6539-80) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Filter Housing Assembly, 60B83104-1, Serial 69 was discovered leaking from a defect in the side of the housing. The housing is 7075-T6 aluminum alloy. Examination of the fracture pattern and material microstructure led to the conclusion that failure was by stress corrosion cracking. Future failures of the part by stress corrosion cracking can be avoided by heat treating the housing to a T73 temper. Author

N67-27510*# Boeing Co., Seattle, Wash. Launch Systems Branch.
METALLURGICAL ANALYSIS OF HANDLING TOOL FORWARD BOOSTER ASSEMBLY
R. R. Sands 30 Nov. 1966 8 p
(Contract NAS8-5608)
(NASA-CR-84476) CFSTI: HC $3.00/MF $0.65 CSCL 13I

The lifting eye weldment after proof load testing showed repeated presence of cracks. The metallurgical test revealed strength below drawing requirements and decarburization on top and bottom surfaces of the tool. It was recommended that, if the part is to be used in present conditions, magnaflux inspection should be performed after each loading and any cracks removed. Author

N67-27519*# Boeing Co., Seattle, Wash. Launch Systems Branch.
THRUST RING SPLICE ANGLE INVESTIGATION
R. R. Sands 9 Dec. 1966 11 p
(Contract NAS8-5608)
(NASA-CR-84479) CFSTI: $3.00 CSCL 13H

The failed thrust ring splice angle (60B18616-1) discovered during the post test shake down inspection of the S–IC "D" vehicle, was analyzed. Standard metallurgical testing and electron fractography revealed that the crack inception was on the faying side of the angle and was due to stress corrosion. Author

N67-27650*# Boeing Co., Seattle, Wash. Launch Systems Branch.
INVESTIGATION OF X-RAY INDICATIONS IN GOX LINE WELD
R. R. Sands [1966] 12 p
(Contract NAS8-5608)
(NASA-CR-84497; T5-6539-78) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Numerous defect indications were revealed in the 4-1/2" GOX tube by X-ray. Bend tests proved that tubes containing these indications were brittle in the weld areas. Metallurgical tests and vendor plant inspection point to incipient melting of the weld fusion line as the cause of the indications. Proper heat treatment controls eliminated the problem. Author

N67-27738# Lockheed Missiles and Space Co., Palo Alto, Calif.
EXPERIMENTAL INVESTIGATION OF THE STRENGTH PROPERTIES OF ORGANIC GLASS UNDER DYNAMIC LOADING
M. F. Drukovanyi, V. G. Zhurba, and V. M. Komir [1967] 2 p refs Transl. into ENGLISH from Fiz.–Khim. Mekh. Materialov (USSR), v. 3, no. 1, 1967 p 61–62

Sheets of organic glass were loaded by exploding a high explosive charge placed in a cylindrical cavity drilled in the sheet. The study sought to determine the difference in the principal stresses on the boundary of the unfractured portion of a sheet with a local fracture zone, i.e., the critical difference in the principal stresses. The magnitude of the critical difference in the principal stresses was determined for different explosive pulse intensities and durations as well as for different sheet thicknesses. An optical-polarization method was used to record some of the cylindrical stress wave parameters propagated in the sheet during the

explosion. Results show that in the local granulation zone, the sheet material strength is determined by the magnitude of the critical difference in the principal stresses, which is independent of the explosive intensity and duration. In addition, this magnitude is approximately equal to the magnitude of the time resistance to breakage under static loading. R.N.A.

N67-27751*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH ACHIEVEMENTS REVIEW, VOLUME II. REPORT NO. 5: QUALITY AND RELIABILITY ASSURANCE RESEARCH AT MSFC
1966 36 p refs
(NASA-TM-X-53602) CFSTI: HC $3.00/MF $0.65 CSCL 14D

CONTENTS:

1. FAST SCAN INFRARED MICROSCOPE FOR IMPROVING MICROELECTRONIC DEVICE RELIABILITY L. C. Hamiter, Jr. p 1–7 (See N67-27752 14-14)

2. USE OF SLURRIES FOR HYDROSTATIC TESTING F. E. Wells p 9–11 (See N67-27753 14-32)

3. AUTOMATED ULTRASONIC SCANNING BY TRIANGULATION METHODS—THE DICKINSON SYSTEM R. L. Brown p 13–17 (See N67-27754 14-14)

4. ULTRASONIC EMISSION DETECTOR EVALUATION OF THE STRENGTH OF BONDED MATERIALS J. B. Beal p 19–27 (See N67-27755 14-15)

N67-27755*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ULTRASONIC EMISSION DETECTOR EVALUATION OF THE STRENGTH OF BONDED MATERIALS
James B. Beal *In its* Res. Achievements Rev., Vol. II, No. 5 1966 p 19–27 refs (See N67-27751 14-15)

A program to measure adhesive bond strength was conducted. A study into the causes for weak adhesive bonds was made to determine the best methods of nondestructive testing of the adhesives. The discontinuities in the bond layer are discussed and related to ultrasonic signals. Bond stress methods and possible test techniques are listed. The measurement of bond strength by producing consistent weak bonds and the causes for the weak bonds are discussed. Fabrication of test samples are presented. The operation and capabilities of the ultrasonic emission detection equipment are explained, and the advantages and disadvantages of the equipment are listed. Author

N67-27764# Atomic Energy of Canada, Ltd., Toronto (Ontario).
THE FABRICATION AND METALLURGICAL EVALUATION OF 3-1/4 IN. DIAMETER COLD-WORKED ZIRCONIUM–2-1/2% NIOBIUM PRESSURE TUBES
B. A. Cheadle and W. Evans Dec. 1966 39 p refs
(AECL-2652) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

Tubes made by extrusion and cold-drawing ≈22% were stronger than tubes which were annealed between extrusion and drawing. The UTS of the strongest tubes exceeded 70,000 psi at 300°C. Generally, back ends of tubes were stronger than front ends and the transverse strengths were higher than longitudinal ones. These properties are correlated with the textures. A post-fabrication anneal at 400°C for 72 hours had little effect on the UTS of the strongest tubes, but the .2% yield strength decreased by up to 24%. Annealing at 500°C for 10 hours weakened all the tubes. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N67-26515*# Arizona Univ., Tucson.
NARROWBAND OPTICAL HETERODYNE DETECTION
J. Hanlon and S. F. Jacobs Jan. 1967 14 p refs Sponsored in part by NASA
(NASA-CR-84149; TR-12) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The technique of coherent detection has been used to explore the problems involved in detecting extremely low power levels. An input signal power level of 5×10^{-19} watts of 3.39μ radiation was detected with voltage S/N of 2, in good agreement with theory. The major experimental problem was elimination of feedback from the local oscillator into the laser source. Narrowness of bandwidth was limited by instability in detector bias. Neither of these difficulties presents a fundamental limitation to a well designed receiver of light from a distant source. Author

N67-26537*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
LONG-TERM LASER FREQUENCY STABILIZATION USING A MOLECULAR BEAM
S. Ezekiel *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 105–108 (See N67-26521 14-21)

Brief technical details are presented on the present status of frequency stabilization techniques, and the proposed approach to laser stabilization by using a molecular beam. The method of utilizing the atomic, or molecular, beam as the frequency reference for the long term stabilization of a laser is described, and a pertinent schematic is included. R.Li.

N67-26703# Pennsylvania State Univ., University Park. Dept. of Physics.
[RESEARCH ON PROJECTS OF THE DEPARTMENT OF PHYSICS] Technical Report, 1 Jan.–31 Dec. 1966
D. H. Rank 31 Dec. 1966 86 p refs
(Contract Nonr-656(12))
(AD-647364)

CONTENTS:

1. RESOLUTION AND EFFICIENCY OF SINGLE AND DOUBLE PASS SPECTROGRAPHS J. A. Lowenthal, D. H. Rank, and T. A. Wiggins 11 p refs (See N67-26704 14-14)

2. SPONTANEOUS BRILLOUIN SCATTERING IN GASES D. P. Eastman, T. A. Wiggins, and D. H. Rank 3 p refs (See N67-26705 14-16)

3. DEPOLARIZATION OF THE COMPONENTS OF RAYLEIGH SCATTERING IN LIQUIDS D. H. Rank, A. Hollinger, and D. P. Eastman 11 p refs (See N67-26706 14-16)

4. STIMULATED EFFECTS IN N_2 AND CH_4 GASES T. A. Wiggins, R. V. Wick, and D. H. Rank 17 p refs (See N67-26707 14-16)

5. PERFORMANCE OF A VIBRATION H_2-STOKES OSCILLATOR P. V. Avizonis, A. H. Guenther (AF Weapons Lab.), T. A. Wiggins, R. V. Wick, and D. H. Rank 10 p refs (See N67-26708 14-16)

6. STIMULATED OPTICAL FREQUENCY MIXING IN LIQUIDS AND SOLIDS R. V. Wick, D. H. Rank, and T. A. Wiggins 6 p refs (See N67-26709 14-16)

7. OPTICAL MIXING IN STIMULATED BRILLOUIN SPECTRA T. A. Wiggins, R. V. Wick, N. D. Foltz, C. W. Cho, and D. H. Rank 16 p refs (See N67-26710 14-16)

8. STIMULATED RAYLEIGH SCATTERING C. W. Cho, N. D. Foltz, D. H. Rank, and T. A. Wiggins 9 p refs (See N67-26711 14-16)

N67-26705# Pennsylvania State Univ., University Park. Dept. of Physics.
SPONTANEOUS BRILLOUIN SCATTERING IN GASES

D. P. Eastman, T. A. Wiggins, and D. H. Rank *In its* [Res. Proj. of the Dept. of Phys.] 31 Dec. 1966 3 p refs Supported by ONR (See N67-26703 14-16)

Reported are observations of spontaneous Brillouin scattering at 90°C in carbon dioxide and nitrogen gases. Observations were made using a recently constructed 250 milliwatt He–Ne laser. Results of stimulated Brillouin effects are also cited. At 36°C the measured sound speed in carbon dioxide gas was 637±10 m/sec. The frequency of the sound above experimental conditions was 1.7 gigacycles per second. No dispersion was noted since this value of sound velocity agreed with experimental error in previous determinations at 2.2 gigacycles per second which were made using giant pulse methods. It was observed that in the spontaneous Brillouin effect with carbon dioxide gas the depolarization of the Rayleigh and Brillouin components was less than 0.02. The spontaneous Brillouin effect in gaseous nitrogen was observed at a gas density of 300 amagats at 25°C. Preliminary measurements yielded a value for the sound speed of 490±20 m/sec, which was in agreement with the value obtained by extrapolation from the stimulated Brillouin measurements. It is surmised that this is the first observation of the spontaneous Brillouin effect in gases, and that these findings demonstrate the feasibility of studying sound propagation in the gigacycle region with a high intensity continuous laser source. S.C.W.

N67-26706# Pennsylvania State Univ., University Park. Dept. of Physics.

DEPOLARIZATION OF THE COMPONENTS OF RAYLEIGH SCATTERING IN LIQUIDS

D. H. Rank, Amos Hollinger, and D. P. Eastman *In its* [Res. Proj. of the Dept. of Phys.] 31 Dec. 1966 11 p refs Supported by ONR (See N67-26703 14-16)

The depolarization ratios have been determined in eight liquids by employing a He–Ne laser as a source and Fabry Perot interferometer techniques. Individual depolarization ratios were obtained for the separate Rayleigh components scattered at 90°. In most cases the Brillouin components were strongly polarized and the total depolarization was predominantly due to the depolarized background. The temperature dependence of the Rayleigh component gives some evidence for the presence of ordering in some liquids. Author

N67-26707# Pennsylvania State Univ., University Park. Dept. of Physics.

STIMULATED EFFECTS IN N_2 AND CH_4 GASES

T. A. Wiggins, R. V. Wick, and D. H. Rank *In its* [Res. Proj. of the Dept. of Phys.] 31 Dec. 1966 17 p refs Supported by ONR (See N67-26703 14-16)

Stimulated Brillouin scattering from N_2 and CH_4 using a giant pulse laser has been observed in an arrangement whereby the laser cannot re-lase and amplify the backscattered radiation. This allows a quantitative study of the parameters affecting stimulated Brillouin scattering. The backscattered beam converges at the same angle at which the laser beam diverges. The Brillouin component can have a narrow spectral width, 1/3 that of the laser itself, and in some cases can have a duration of only a few nanoseconds. N_2 at high pressure can backscatter as much as 45% of the incident power. The speeds of sound in CH_4 and N_2 have been measured at lower pressures than were previously reported. Author

N67-26708# Pennsylvania State Univ., University Park. Dept. of Physics.

PERFORMANCE OF A VIBRATION H_2-STOKES OSCILLATOR

P. V. Avizonis, A. H. Guenther (AF Weapons Lab.), T. A. Wiggins, R. V. Wick, and D. H. Rank *In its* [Res. Proj. of the Dept. of Phys.] 31 Dec. 1966 10 p refs Supported by ARPA (See N67-26703 14-16)

A H_2-Stokes Raman Oscillator was constructed operating at 9755 Å, and its performance was found to be as expected of laser oscillators. No beam instability was developed (beam trapping), confirming earlier measurements. A significant beam brightness enhancement (in terms of linewidth and beam divergence) over that of the Q-switched ruby laser resulted. Author

N67-26709# Pennsylvania State Univ., University Park. Dept. of Physics.

STIMULATED OPTICAL FREQUENCY MIXING IN LIQUIDS AND SOLIDS

R. V. Wick, D. H. Rank, and T. A. Wiggins *In its* [Res. Proj. of the Dept. of Phys.] 31 Dec. 1966 6 p refs Supported by ONR (See N67-26703 14-16)

Described are experimental observations of ruby laser stimulated optical frequency mixing in two liquids (carbon disulfide and aniline) and two optical glasses. Remarks concerning previous observations of the stimulated Brillouin effect in liquids and solids are included to clarify experimental findings. S.C.W.

N67-26710# Pennsylvania State Univ. University Park. Dept. of Physics.

OPTICAL MIXING IN STIMULATED BRILLOUIN SPECTRA

T. A. Wiggins, R. V. Wick, N. D. Foltz, C. W. Cho, and D. H. Rank *In its* [Res. Proj. of the Dept. of Phys.] 31 Dec. 1966 16 p Supported by ONR and NSF (See N67-26703 14-16)

Optical mixing in twenty-three liquids and two glasses is reported. Observations with a high-resolution grating spectrograph of the light from a giant-pulse ruby laser transmitted through the materials reveal the presence of more Stokes-shifted components than can be accounted for on the basis of amplification by the laser of Brillouin shifted frequencies. In addition, anti-Stokes shifted components are observed. The frequency shifts are shown to correspond to those expected for 180° Brillouin scattering. Sound speeds calculated agree in general with those from stimulated and spontaneous scattering experiments. Sound-speed measurements at different temperatures and for two-component liquids give results predictable from bulk properties of the liquids. A number of experiments showing the conditions and the parameters which affect the optical mixing are described. Author

N67-26711# Pennsylvania State Univ., University Park. Dept. of Physics.

STIMULATED RAYLEIGH SCATTERING

C. W. Cho, N. D. Foltz, D. H. Rank, and T. A. Wiggins *In its* [Res. Proj. of the Dept. of Phys.] 31 Dec. 1966 9 p refs Supported by ONR and NSF (See N67-26703 14-16)

Reported are results of spectrographic observations of ruby laser stimulated Rayleigh scattering from liquids. S.C.W.

N67-26752# Brandeis Univ., Waltham, Mass. Dept. of Physics.

THEORY OF AN OPTICAL MASER IN A MAGNETIC FIELD

Peter Hammerling Oct. 1966 13 p refs

(Contract AF 19(628)-5833)

(SR-2; AFCRL-66-813; AD-648238) CFSTI: HC $3.00/MF $0.65

The theory of an optical maser in the presence of an external static magnetic field has been discussed recently by several authors. It is now shown that a considerable simplification of the theory results when one uses a tensor operator expansion of the density matrix describing the system. Author (TAB)

N67-26758# Raytheon Co., Waltham, Mass. Research Div.

MODE-LOCKING AND MODE PROPERTIES OF OPTICAL LASERS Final Scientific Report, Jan.–Dec. 1966

H. Statz and G. A. de Mars Mar. 1967 63 p refs

(Contract AF 19(628)-5819)

(S-928; AFCRL-67-0084; AD-648262) CFSTI: HC $3.00/MF $0.65

The report contains: Self-Locking in Modes in Lasers and phase-locking effects between longitudinal modes in lasers. The expected phases of oscillating modes depend in a complicated manner upon the relaxation times T1 and T2 of the medium, on the degree of inhomogeneous broadening, the mode separation and location of the medium in the cavity. Simple formation of sharp output spikes at the fundamental frequency are expected where crystals like ruby or YAG are placed near the edges of the cavity. Sharp spikes at twice the fundamental frequency are expected when these solids are placed in the center of a cavity. Investigations have been completed on the mode-locking in ruby lasers where the crystals are located near the mirrors or in the center of the cavity. The observed results are in agreement with the theory. Phase-Locking of Laser Oscillators by Injected Signal and the Minimum Frequency Separation in Rotation Sensing Ring Lasers. The condition for frequency-locking of a laser oscillator by an externally injected signal is derived. The results are valid for both homogeneously and inhomogeneously broadened lines. Effects of Intensity-Dependent Anomalous Dispersion on the Mode Shapes of Fabry-Perot Oscillators. Previous work in this laboratory, as well as work by Fox and Li, has shown that the mode shapes in Fabry-Perot resonators do not change much due to the intensity-dependent saturation of the laser medium. The only effect sometimes expected with curved mirrors is that the lowest threshold oscillating mode is not the Te00 mode but one exhibiting radial nodes. However, the calculations assume that the laser oscillation is one line center. Author (TAB)

N67-26779# Linde Div., Union Carbide Corp., Indianapolis, Ind.
CZOCHRALSKI GROWTH OF La–AlO_3 Semiannual Report, 1 Aug. 1966–31 Jan. 1967
H. M. Dess, S. R. Bolin, and O. H. Bolin 28 Feb. 1967 30 p refs
(Contract Nonr-4793(00); ARPA Order 306)
(SRCR-67-3; AD-648454) CFSTI: HC$3.00/MF$0.65

Good quality spinel single crystals both undoped and Cr(+3)-doped were grown via a modified Czochralski process similar to that utilized for the growth of LaAlO3. Spectroscopic studies of Cr(+3)-doped samples indicate a half-intensity line width at room temperature of about 50A for the principal component centered around 6876A. Fluorescent lifetimes of 12 and 11 milliseconds were measured at -183C and 24C respectively for this component. Several much narrower bands of variable intensity depending upon the radiation history of the specimen were also observed. The absorption spectrum of Cr(+3)-MgAl2O4 resembles that of ruby, but the absorption coefficients are significantly lower. Lasing tests carried out with fabricated rods of Cr-doped spinel have thus far not yielded any detectable laser output. Lasing attempts with Cr:LaAlO3 rods fabricated from crystals grown during the course of this program have likewise not yet proved successful. Author (TAB)

N67-27125 Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
THE POTENTIALS OF PRESENT DAY LASERS AS SCIENTIFIC PROBES FOR INVESTIGATING THE STRUCTURE OF MATTER
J. L. Hughes Jan. 1967 16 p refs
(WRE-TN-PAD-126)

A survey of the techniques required to produce photon energy densities in the range 10^{17} to 10^{25} ergs per cm^3 is given. It is concluded that light amplification using rods cannot achieve these powers and the concept of the exponential amplifier is proposed together with the results of some initial optical tests. It is concluded that the most likely present day contender is neodymium doped glass although the costs involved would be comparable to those of the most powerful of particle accelerators built to date. The major part of this cost would go into the development of photo emitting diodes with a 100Å band at 8800Å capable of several kilowatts pulsed power over a one cm^2 aperture in about 300μs. Author

N67-27128# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
LASER MODULATION USING LINEAR ELECTRO-OPTIC CRYSTALS
J. R. Pyle Dec. 1966 40 p refs
(WRE-TN-PAD-125) CFSTI: HC$3.00/MF$0.65

The theory of laser modulation using the linear electro-optic effect exhibited by certain crystals is described. Basic modulator configurations have been investigated theoretically and experimentally and good agreement has been found. The use of multiple crystal modulators is advocated for increased modulation sensitivity to driving voltage. Television transmission over a Helium–Neon laser beam is described. Author

N67-27179# Illinois Univ., Urbana. Electro-Physics Lab.
GAS LASER STUDIES IN THE 100 TO 1000 MICRON RANGE—A REVIEW OF ACTIVITIES Final Report, 1 Jan.–30 Sep. 1966
Paul D. Coleman Dec. 1966 31 p refs
(Grant AF-AFOSR-804-66)
(AFOSR-67-0689; AD-648760) CFSTI: HC$3.00/MF$0.65

The report summarizes nine months of the second year activity of research on molecular lasers in the 100 to 1000 micron range. Progress on identifying the lasing specie and making energy level assignments for a water vapor laser are described. Also included is a summary of optimum output coupling of lasers by means of apertures and semi-transparent mirrors. This study was carried out at 337 microns wavelength. Author (TAB)

N67-27287*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPTICAL AND MICROWAVE COMMUNICATIONS—A COMPARISON
F. Kalil Washington, NASA, Jun. 1967 46 p refs
(NASA-TN-D-3984) CFSTI: HC$3.00/MF$0.65 CSCL 20E

Some preliminary comparisons are made of microwave, millimeter, and optical communication systems for space communication from a spacecraft at Mars distances. Thermal, quantum, and sky noise is discussed, as well as microwave, millimeter wave, and optical technology; acquisition and tracking; and mission analysis. Based on the considerations herein, it appears likely that in the radio spectrum, the S-Band is the better place to operate. However, optical communication systems probably have the greater potential for higher data rates—up to about 10^9 bps at Mars distances. Author

N67-27499# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
INTENSE PULSED SOURCES OF IONS AND ELECTRONS PRODUCED BY LASERS [SOURCES PULSEES INTENSES D'IONS ET D'ELECTRONS PRODUITS PAR LASER]
Guy Bourrabier, Terenzio Consoli, and Lucien Slama Nov. 1966 21 p In FRENCH
(CEA-R-3109)

A device is described for the acceleration of plasma bursts produced by focusing a laser beam into a metal target. The electrons and ions are extracted from the plasma. The maximum current is around 2000 amperes for a few microseconds. The study of the effect of the kind of target on characteristics of the current shows the great importance of initial conditions, i.e., the ionization potential of the target and the laser energy. Author (NSA)

N67-27689*# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
ABSOLUTE FREQUENCY MEASUREMENT OF THE 190μ AND 194μ GAS LASER TRANSITIONS

L. O. Hocker, D. Ramachandra Rao, and A. Javan [1967] 5 p refs
(Grant NsG-330)
(NASA-CR-84508) CFSTI: HC $3.00 CSCL 20E

By harmonic mixing with a 70 GHz source, the frequencies of the 190 and 194μ laser transitions in a D_2O and C_2N_2 discharge have been measured as 1578.279 and 1539.756 GHz. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N67-26487# Massachusetts Inst. of Tech., Cambridge.
INVESTIGATION OF FRACTURE IN CONNECTION WITH HOT DEFORMATION PROCESSING OF METALS Final Report
Nicholas J. Grant, Peter Bridenbaugh, Barry Greene, and Robert Kane Dec. 1966 29 p
(Contract NOw-66-0104-d)
(AD-648451) CFSTI: HC $3.00/MF $0.65

Topics included are: Hot plasticity at high strain rates and high temperatures of iron; Deformation and fracture characteristics of Udimet 700 at high strain rates and high temperatures; Deformation and fracture studies of molybdenum and its alloys at high strain rates and high temperatures. TAB

N67-26504* Case Inst. of Tech., Cleveland, Ohio. Metallurgy Dept.
THE EFFECT OF DEFORMATION ON DISPERSION HARDENED ALLOYS Semiannual Status Report
G. S. Doble, L. Leonard, and L. J. Ebert Apr. 1967 36 p refs
(Grant NGR-36-003-094)
(NASA-CR-84160) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The recrystallization behavior of TD Nickel in as-extruded and commercial bar form was studied after rolling and swaging. The recrystallization behavior was found to be intimately related to the mechanical working process and direction. For comparable reductions, deformation at cross directions to the initial bar axis produced recrystallization while deformation in the direction of the bar axis had a negligible effect. Some materials which recrystallized at low reductions would not recrystallize after larger reductions. Results are discussed briefly in terms of a postulated deformation-induced recrystallization-resistant structure which develops during mechanical working. The elevated temperature strength of a coarse grain recrystallized structure was found to be higher than fine grained cold worked bar stock. Analysis of tensile data near 2000°F gave an activation energy of 200–330 K-cal/mol for the recrystallized structure and 185–220 K-cal/mol for the fine grained cold worked bar. It is concluded that the high recrystallized tensile strength is not due to a change in rate controlling mechanism with grain size as proposed for creep of SAP and nickel–thoria alloys. Author

N67-26579*# Scientific Translation Service, La Canada, Calif.
EFFECT OF TITANIUM, ZIRCONIUM AND HAFNIUM ON THE PROPERTIES OF MOLYBDENUM–CARBON ALLOYS [VLIYANIYE TITANA, TSIRKONIYA, I GAFNIYA NA SVOYSTVA SPLAVOV MOLIBDENA S UGLERODOM]
N. N. Morgunova Washington, NASA, Apr. 1967 7 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 12, 1966 p 40–44
(Contract NASw-1498)
(NASA-TT-F-10859) CFSTI: $3.00 CSCL 11F

The heat resistance of two series of molybdenum alloys was determined from tests on the lasting stability of recrystallized samples and also from their recrystallization temperature. The first of the series contained molybdenum with 0.25 at.% C as a base alloyed with 0.25 at.% Ti, Zr, or Hf. The second series consisted of the same alloys but with a content of alloying elements and carbons of 0.5 at.%. Results regarding the comparative effect of Ti, Zr, and Hf on the heat resistance of molybdenum with the addition of carbon showed that the recrystallization temperature and lasting stability do not change when the carbon content increases in molybdenum from 0.25 at.% to 0.5 at.%. Titanium is the least effective when carbon occurs in molybdenum, while alloying up to 0.25 at.% with zirconium represents the most effective addition. When the alloying element content increases up to 0.5 at.%, hafnium is most effective, followed by zirconium. R.N.A.

N67-26634*# TRW Equipment Labs., Cleveland, Ohio. Materials Research and Development Dept.
GENERATION OF LONG TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES Quarterly Report, 26 Mar.–26 Jun. 1966
J. C. Sawyer and E. A. Steigerwald 15 Jul. 1966 93 p
(Contract NAS3-2545)
(NASA-CR-72044; QR-12) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Extensive creep data are presented for vapor deposited tungsten, TZC, TZM, niobium-modified TZM, and T-111 alloys. The test data are graphed as percent elongation in the two inch gauge section as a function of the time of the applied stress, and the numerical data are tabulated. The results are discussed in detail. Changes in the procedures of the residual gas analysis are indicated, and the gases present in the creep systems under test at 1×10^{-8} torr are listed in order of decreasing intensity. N.E.N.

N67-26638*# General Electric Co., Cincinnati, Ohio.
ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report, Period Ending 15 Jan. 1967
R. W. Harrison, ed. 28 Jan. 1967 56 p
(Contract NAS3-6474)
(NASA-CR-72230; QPR-7) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The T-111 alloy tubing was received and quality assurance inspection is in progress. Most of the T-111 alloy materials were released for the manufacture of critical components; the remaining necessary materials are being inspected. Fabrication and installation of the lithium still into the purification system was completed and outgassing is in progress. Fabrication of many of the loop components is in progress. Author

N67-26676# Israel Inst. of Tech., Haifa. Material Mechanics Lab.
THE INFLUENCE OF STRAIN RATE AND STRAIN AGEING ON THE FLOW STRESS OF COMMERCIALLY PURE ALUMINUM
A. Rosen and S. R. Bodner Aug. 1966 43 p refs
(Contract AF 61(052)-951)
(MML-3; SR-1; AFOSR-66-2587; AD-641995) CFSTI: HC $3.00/MF $0.65

Tensile tests on annealed, commercially pure aluminum specimens were performed in a hard machine at different temperatures for a number of constant strain rates. The results show that a range of strain, strain rate, and temperature exists for which the flow stress decreases with strain rate. This material property, when coupled with suitable mechanical conditions, is believed to be cause of discontinuous, repeated yielding. Various experiments, especially relaxation and reloading tests, show that the decrease of flow stress with strain rate can be directly attributed

to rapid strain ageing due to impurity diffusion. Other experiments indicate the same effect for different loading histories. An analytical representation of the strain rate and strain ageing of the material is developed which predicts results in very good agreement with the experiments. Author (TAB)

N67-26757# Purdue Univ., Lafayette, Ind.
THERMOPHYSICAL PROPERTIES OF HIGH TEMPERATURE SOLID MATERIALS Final Technical Report, 1 Jul. 1964–30 Jun. 1966
G. Wang Jun. 1966 35 p refs
(Contract AF 33(615)-1642)
(AFML-TR-66-265; AD-648235) CFSTI: HC $3.00/MF $0.65

A general description is given of the format and method of presenting data, methods and techniques for the collection, evaluation, processing, and retrieval of information in the preparation of the work entitled, Thermophysical Properties of High Temperature Solid Materials. This major work on thermophysical properties will be available commercially early in 1967. Author (TAB)

N67-26780# Titanium Metals Corp. of America, New York.
METASTABLE BETA SHEET ALLOY Ti–8Mo–8V–2Fe–3Al, PART I Final Technical Report
Donald B. Hunter Oct. 1966 101 p
(Contract DA-30-069-ORD-3743)
(WAL-TR-405/2-14, Pt. 1; AD-648244) CFSTI: HC $3.00/MF $0.65

A 500-lb. ingot of metastable beta alloy Ti-8Mo-8V-2Fe-3Al was melted and mill processed to plate and sheet for evaluation. No processing problems were encountered. Plate samples were evaluated in 2 in and 1/2 in sections; room temp. and 600F smooth and notched tensile properties and K sub ic values were obtained. Samples taken from both sections of plate, when solution treated and aged for 16 hrs. at 900F, had room temp. yield strengths of 190-200Kpsi; K sub ic values were 45-48Kpsi-square root of (in). Sheets of 0.040 and 0.060 in gage were evaluated by determining 50 and 100% recrystallization parameters, using mill annealed sheet and hot rolled sheet given 25 and 50% cold reduction. Aging response of these materials was then determined at 800-1200F and tensile properties evaluated after selected treatments. From this, 8 conditions of heat treatment were selected for further evaluation by sub-zero and 600F smooth and notched tensile, bend, notched fatigue and K sub ic tests, measurement of creep stability; stress corrosion resistance and oxidation characteristics; and study of welding behavior. Ti-8Mo-8V-2Fe-3Al possessed good notch tensile strength over the range of -65 to 600F; the notched fatigue limit, with a notch configuration of Kt = 3.5, was 30-35Kpsi, and the plane strain crack propagation resistance was 45-60Kpsi-square root of (in). Creep curves were obtained, employing loads of 90% of the yield strength at 600F, for exposure times of 500 hrs. Author (TAB)

N67-26815# Israel Inst. of Tech., Haifa. Material Mechanics Lab.
DISCONTINUOUS YIELDING OF COMMERCIALLY PURE ALUMINUM
S. R. Bodner and A. Rosen Sep. 1966 39 p refs
(Contract AF 61(052)-951)
(MML-4; SR-2; AFOSR-66-2607; AD-641990) CFSTI: HC $3.00/MF $0.65

The discontinuous, repeated yielding of commercially pure aluminum under slowly applied dead weight loading is examined as a dynamic instability problem. The destabilizing factor is shown to be the negative slope of the flow stress–strain rate relation which, for aluminum, is a consequence of rapid strain ageing. The essentials of the phenomenon are illustrated by a dry friction model which incorporates a counterpart of strain hardening. More generalized models show the equivalent of progressive yielding over the specimen length and delayed yielding under incremental loading. A stepped stress–strain curve is derived from the experimental flow stress–strain rate relation which agrees well with the observations in dead weight loading tests. Additional experiments on an Instron testing machine were performed with variable machine flexibility and strain gage recording. These test results support the explanation of the origin of the stepped stress–strain curves. Author (TAB)

N67-26869# Titanium Metals Corp. of America, New York.
SCREENING AND SELECTION OF CANDIDATE SHEET ALLOYS Final Report, Part II
Donald B. Hunter Watertown, Mass., Army Mater. Res. Agency, Dec. 1966 174 p refs
(Contract DA-30-069-ORD-3743)
(WAL-TR-405/2-15; AD-648245) CFSTI: HC $3.00/MF $0.65

Three alloys were selected as being suitable for addition of elements designed to bring about precipitation hardening: Ti-17V-10Cr-3Al, Ti-8Mo-8V-7.5Fe-3Al and Ti-15Mo-5Fe-3Al. Addition of 0.5-1%Si to Ti-17V-10Cr-3Al followed by water quenching from solution temperatures of around 2000F and aging at 1150-1250F, produced Vickers hardness increases of up to 100 points upon aging without visible microstructural change. Although precipitation hardening of a stable beta alloy was thus achieved, grain growth and embrittlement were encountered because of the high temperatures required to dissolve the silicide. Work was then redirected toward development of two other types of alloy: a moderate strength stable beta alloy, and a high strength metastable beta alloy hardenable by alpha precipitation. Two stable beta alloys, Ti-17V-10Mn-3Al and Ti-8Mo-8V-6Fe-3Al, and two metastable beta alloys, Ti-17V-4Fe-3Al and Ti-8Mo-8V-2Fe-3Al were evaluated. However, the stable beta alloys had brittle welds, and work on these was discontinued. They were replaced by stabilized alloys, metastable alloys aged at 1100-1200F to suppress the maximum aging response and reach a strength plateau. Four such alloys-Ti-8Mo-8V-5Co-3Al, Ti-17V-7.5Co-3Al, Ti-17V-2Fe-2Co-3Al and Ti-8Mo-8V-2Fe-3Al - were evaluated in this condition. Ti-8Mo-8V-2Fe-3Al proved to be best of the high strength metastable beta candidates. On a basis of smooth and notched tensile properties at room temperature and 600F, creep stability and stress corrosion resistance, Ti-8Mo-8V-2Fe-3Al was selected for mill production. Author (TAB)

N67-26886# Cornell Univ., Ithaca, N. Y.
VARIATION OF RESOLVED PROPORTIONAL LIMIT WITH MOSAIC ANGLE FROM 77°K TO 973°K IN ZONE REFINED TUNGSTEN
Ronald Paul Simpson Feb. 1967 120 p refs
(Contract DA-31-124-ARO(D)-228)
(AD-648375) CFSTI: HC $3.00/MF $0.65

Tungsten crystals were prepared and purified by electron beam zone refining. A range of mosaic block angles was obtained by controlling the temperature at the molten zone. The tensile axis of the single crystals was determined from laue back reflection X-ray patterns, and tensile properties were then determined as a function of strain rate and temperature. The resolved proportional limit at constant strain rate of the tungsten crystals varied over a mosaic block angle from 3 to an upper limit of 8–10. Both the resolved proportional limit and its range, as a function of mosaic angle, decreased with increasing temperature. Activation volumes were calculated varying inversely with temperature for both mosaic limits. The range of resolved proportional limit with mosaic angle at constant temperature and strain rate is interpreted in terms of the variation of boundary energy with mosaic angle. The tungsten crystals contained interstitial elements in excess of their solubility limit, even though their total interstitial content was below 100 ppm. The elements in solution have an increasing tendency to migrate to the mosaic boundaries with increasing temperature and mosaic angle and consequently have an important effect on the resolved proportional limit. Author (TAB)

N67-26890# Illinois Univ., Urbana.
INFLUENCE ON THERMAL AND STRAIN CYCLING ON FRACTURE SUSCEPTIBILITY OF MILD STEEL
J. F. Kiefner and W. H. Munse Feb. 1967 131 p refs *Its* Structural Ser. No. 319
(Contract NObs-88283)
(AD-647906) CFSTI: HC $3.00/MF $0.65

The principal fracture controlling parameters and the effects of welding thereon are discussed. From the results of tests on notched and welded specimens it was apparent that the effect on fracture behavior of the thermal and strain cycling that occurs during welding is not fully understood. Notched bend specimens subjected to a cycle of axial prestraining at temperatures usually in the range of 300 to 800F were tested to evaluate the fracture behavior of three structural steels, ABS-C, A212-B, and A441 steels. It was found that cracking occurred in some of the hotstrained specimens of ABS-C and A212-B steels at loads as low as 87 percent of the yield load when they were tested at temperatures of -80 of +80F. One specimen of A441 steel also exhibited cracking at 88 percent of the yield load at a temperature of -40F, but in most cases the hot-strained A441 steel specimens showed greater resistance to fracturing than those of the other two steels. Some of the notched bend specimens of the ABS-C steel exhibited cracking during the axial prestraining at a temperature in the range of 300 to 600F. Similarly, cracking occurred during welding at the root of notches in some of the notched and welded specimens of ABS-C steel. Specimens which cracked during hot-straining are apparently less susceptible to fracturing at low applied loads. TAB

N67-26935# Wayne State Univ., Detroit, Mich.
RECOVERY PROCESSES AND ORDERING IN Ni_3Al
Clark L. Corey and Donald I. Potter Jan. 1967 31 p refs
(Contract Nonr-4520(00))
(TR-2; AD-646602) CFSTI: HC $3.00/MF $0.65

Isothermal changes in long-range order, S, x-ray line shifts due to stacking faults, delta, and x-ray particle size from Fourier analysis of line shapes, D, were measured for filed samples of Ni3Al. Recovery temperatures between 200 degrees C. and 270 degrees C. were investigated. The recovery of all three measured properties appeared to depend upon the mobility of vacancies in this temperature range. The evaporation of vacancies from faulted loops appeared to supply the vacancy flux for ordering and particle size changes. Fault shrinkage was found to cease quite abruptly between 215 degrees C. and 200 degrees C.; at 200 degrees C. faulting initially increased, during which ordering did not occur, but after some 20 hours the faulting began to anneal out and somewhat later ordering proceeded. An activation energy of 1.65 eV was found for the ordering reaction; this compares with a value of 1.5 eV for E/vm in nickel. Author (TAB)

N67-26938# Catholic Univ. of America, Washington, D. C.
ON THE USE OF THE RING TEST FOR DETERMINING RATE SENSITIVE MATERIAL CONSTANTS
Nicholas Perrone (ONR) Nov. 1966 22 p refs
(Grant NSF GK-782)
(Rept.-3; AD-646609) CFSTI: HC $3.00/MF $0.65

An explosive ring test is reappraised in light of recently developed material behavior models and analytical predictive techniques. It is demonstrated in complete detail how this test may be utilized to determine the uniaxial flow laws of rate sensitive perfectly plastic and strain hardening materials. Author (TAB)

N67-26984# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.
REFRACTORY-METAL ALLOY RESEARCH AND DEVELOPMENT
E. S. Funston and C. O. Tarr *In its* High-Temp. Mater. Program 30 Dec. 1966 p 59–69 refs (See N67-26981 14-22)

The objective of this program is to further the technology of refractory metals, and in particular the new refractory metals developed under this task, to permit the early utilization of these materials in the many high-temperature reactor programs sponsored by the AEC. Continuing research is being conducted to obtain new refractory metals which will make possible marked improvements in the temperature and life capabilities of nuclear power plants. Author (NSA)

N67-26985# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.
PHYSICAL METALLURGY OF REFRACTORY-METAL ALLOYS
C. G. Collins *In its* High-Temp. Mater. Program 30 Dec. 1966 p 71–74 (See N67-26981 14-22)

The objective of this program is to define the physical metallurgy of refractory-metal alloys of the tungsten–rhenium–molybdenum system in terms of phase stability, composition variations, impurity concentrations, and effects resulting from self-diffusion and vaporization processes. Author (NSA)

N67-26988# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.
EFFECT OF RADIATION ON HEAT-RESISTANT METALS AND ALLOYS
J. Moteff and J. P. Smith *In its* High-Temp. Mater. Program 30 Dec. 1966 p 95–106 refs (See N67-26981 14-22)

The objective of this program is to determine the effect of radiation on the time-, temperature-, and stress-dependent properties of heat-resistant metals and alloys at elevated temperatures, to identify the causes of any observed changes in these properties, and to develop remedial measures. Materials to be investigated in this program include A-286, Hastelloy N(INOR-8), Hastelloy X, Hastelloy R-235, Fe–Cr–Al–Y alloys, AISI 304 stainless steel, ASTM-A302B and A350-LF3 pressure vessel steels, and various Inconel and Incoloy alloys. Author (NSA)

N67-26989# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.
EVALUATIONS OF THE PLASTIC FATIGUE PROPERTIES OF HEAT-RESISTANT ALLOYS
J. Moteff and T. Slot *In its* High-Temp. Mater. Program 30 Dec. 1966 p 107–110 refs (See N67-26981 14-22)

The objective of this program is to determine the parameters affecting low-cycle fatigue behavior of metals and alloys at elevated temperatures and to generate low-cycle fatigue data for use in the design of structural components of high-performance nuclear reactor systems. In accordance with this objective, low-cycle fatigue experiments are initially being performed on Types 304 and 316 stainless steels in the temperature range from 400° to 800°C. Specimens are subjected to various cyclic loading conditions, which are characterized by parameters that include strain amplitude, strain rate, and length of hold times at maximum strain. Author (NSA)

N67-26990# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.
ADVANCED PRESSURE VESSEL MATERIALS
F. C. Robertshaw *In its* High-Temp. Mater. Program 30 Dec. 1966 p 111–113 refs (See N67-26981 14-22)

Four materials possessing room-temperature yield strengths of at least 10,400 kg/cm^2 have been identified which may have potential application as high-strength pressure vessel materials. These are a 12-5-3 maraging steel, PH 13-8Mo, Inconel Alloy 718, and a 7.5 Ni–Cr–Mo steel. Plate of the first three of these has been obtained and is undergoing non-destructive inspection. Preparation continued of a critique on high-strength steels and alloys. R.U.

N67-27021# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOSCOW. AVIATION TECHNOLOGICAL INSTITUTE
D. Ya. Vishnyakova 13 Jan. 1967 188 p refs Transl. into ENGLISH from Tr. Mosk. Aviats. Technol. Inst., no. 50, 1961 p 1–186
(FTD-MT-64-90; AD-646733) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. INFLUENCE OF TUNGSTEN, NIOBIUM, AND ZIRCONIUM ON THE STABILITY OF AUSTENITE AND HARDENABILITY OF MACHINE-BUILDING CHROME–NICKEL STEEL D. Ya. Vishnyakov and A. A. Sovalova p 3–11 refs (See N67-27022 14-17)

2. CARBURIZATION OF STAINLESS STEELS D. Ya. Vishnyakov, A. A. Sovalova, and L. P. Chudareva p 13–21 ref (See N67-27023 14-17)

3. CHARACTER OF INTERCRYSTALLINE BRITTLENESS OF TECHNICAL IRON IN COLD STATE D. Ya. Vishnyakov and A. I. Paisov p 23–29 refs (See N67-27024 12-17)

4. INCLINATION OF LOW-CARBON TRANSFORMER STEEL TO MAGNETIC AGING AND METHOD OF APPRAISING THIS INCLINATION D. Ya. Vishnyakov and A. I. Paisov p 31–35 refs (See N67-27025 14-17)

5. ISOTHERMAL TREATMENT OF 13Kh12NVFMA STEEL D. Ya. Vishnyakov, M. A. Figel'man, and G. A. Nazarov p 37–44 (See N67-27026 14-17)

6. INFLUENCE OF HYDROGEN ON STRUCTURE AND PROPERTIES OF VT8 AND VT10 ALLOYS V. A. Livanov, A. A. Bukhanova, and B. A. Kolachev p 45–52 ref (See N67-27027 14-17)

7. INFLUENCE OF MAGNITUDE OF GRAIN ON HYDROGEN EMBRITTLEMENT OF TITANIUM AND ITS ALLOYS V. A. Livanov, A. A. Bukhanova, and B. A. Kolachev p 53–61 refs (See N67-27028 14-17)

8. INFLUENCE OF HYDROGEN ON THERMAL STABILITY OF ALLOY VT3-1 V. A. Livanov, A. A. Bukhanova, and B. A. Kolachev p 63–71 refs (See N67-27029 14-17)

9. INFLUENCE OF OXYGEN AND HYDROGEN ON STRUCTURE AND PROPERTIES OF TITANIUM V. A. Livanov, A. A. Bukhanova, and B. A. Kolachev p 73–80 refs (See N67-27030 14-17)

10. HYDROGEN EMBRITTLEMENT OF TITANIUM ALLOYS WITH ALUMINUM V. A. Livanov, A. A. Bukhanova, and B. A. Kolachev p 81–89 refs (See N67-27031 14-17)

11. DISTRIBUTION OF ALLOYING COMPONENTS IN A TITANIUM INGOT, OBTAINED BY THE METHOD OF MELTING WITH A CONSUMABLE BATCH ELECTRODE V. A. Livanov, M. I. Musatov, and B. A. Kolachev p 91–104 ref (See N67-27032 14-17)

12. CALCULATIONS OF CRYSTALLIZATION OF BINARY ALLOYS A. A. Neustruyev p 105–111 refs (See N67-27033 14-17)

13. PROSPECTS OF APPLICATION OF SILUMIN AS DEFORMABLE ALLOYS V. I. Yelagin p 113–119 refs (See N67-27034 14-17)

14. INVESTIGATION OF THE EFFECT OF THE COMPOSITION ON MECHANICAL PROPERTIES OF AVIAL, HARDENED WITH A LOWERED COOLING RATE V. I. Yelagin and Ya. V. Ekhina p 121–131 refs (See N67-27035 14-17)

15. EFFECT OF THE TYPE OF ADDITION MATERIAL DURING MANUAL ARGON ARC WELDING ON THE PROPERTIES OF JOINTS FROM ALLOY M40 O. S. Bachvar and K. S. Pokhodayev p 133–140 (See N67-27036 14-17)

16. EFFECT OF CONDITIONS OF AUTOMATIC ARGON ARC WELDING ON PROPERTIES OF JOINTS FROM ALLOY M40 O. S. Bachvar and K. S. Pokhodayev p 141–150 (See N67-27037 14-17)

17. DISTINCTIVE FEATURES OF AGING OF ALUMINUM ALLOYS CONTAINING 5% Zn AND 1/2% Mg K. S. Kirpichnikov p 151–160 refs (See N67-27038 14-17)

18. HIGH-SPEED CONDITIONS OF AGING OF ALUMINUM ALLOYS CONTAINING 5% Zn AND 1/2% Mg K. S. Kirpichnikov p 161–167 ref (See N67-27039 14-17)

N67-27022# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF TUNGSTEN, NIOBIUM, AND ZIRCONIUM ON THE STABILITY OF AUSTENITE AND HARDENABILITY OF MACHINE-BUILDING CHROME–NICKEL STEEL
D. Ya. Vishnyakov and A. A. Sovalova *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 3–11 refs (See N67-27021 14-17)

Chrome–nickel steels alloyed with molybdenum, tungsten, niobium, and zirconium were smelted in a high frequency furnace and cast into 40-kg ingots. The critical points of the steels, martensite curves, kinetics of isothermal transformation, and the hardenability are discussed, and the data is tabulated and graphed. It was concluded that: (1) The Mo alloy lowers the critical point, but the other elements have negligible affect. (2) The melting points are all between 270° and 300°C. (3) The S-shaped curves of the Cr–Ni, Cr–Ni–Mo, and Cr–Ni steels with Nb, Zr, and W show the complicated kinetics of the isothermal transformation of austenite. (4) Austenite of Cr–Ni steel is almost equally stable in perlite and troostite regions. (5) Most S-shaped curves shift to the right with an increase of preliminary heating temperature from 830°–850° to 1050°C. (6) Steels with Mo, Zr, and W possess high hardenability in sections larger than 200 mm diameter, and the Cr–Ni steel and the steel with Nb have limited hardenability. N.E.N.

N67-27023# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CARBURIZATION OF STAINLESS STEELS
D. Ya. Vishnyakov, A. A. Sovalova, and L. P. Chudareva *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 13–21 ref (See N67-27021 14-17)

A technological process of pack carburizing stainless steel with an active carburizer and the prevention of oxide films on the surface is described. Details are presented on the protective pastes and graphite, heat treatment, and the additives of NaCl, NH_4Cl, $K_4Fe(CN)_6$, and $BaCo_3$. The results are presented in graph and tabular form, and the recommended composition of carburizers is given. Other conclusions include: (1) a recommended temperature of 950° to 1000°C, (2) a longer chemical–heat treatment leads to an increase of diffusion layer thickness; and (3) optimum conditions of the heat treatment of hardening at 1000° with oil quenching, followed by sub-zero treatment at −60° to −70°C, and subsequent low temperature tempering at 150°–170°C. N.E.N.

N67-27024# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHARACTER OF INTERCRYSTALLINE BRITTLENESS OF TECHNICAL IRON IN COLD STATE
D. Ya. Vishnyakov and A. I. Paisov *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 23–29 refs (See N67-27021 14-17)

The nature of intercrystalline brittleness and the mechanism of the influence of oxygen on the critical temperature of iron brittleness were investigated. The iron specimens containing small amounts of C, Mn, Si, S, P, and O_2 were smelted in open-hearth furnaces, poured into ingots, and then rolled into sheets and annealed. Crack propagation, grain boundaries in brittle and ductile states, and brittle fractures are described. Two possible causes of brittleness, intercrystalline separation and insufficient cohesion between grains, are discussed. It was concluded that the brittleness is caused by intercrystalline adsorption of dissolved oxygen, leading to grain boundary weakening, and not to microscopic inclusion and separations located along grain boundaries. N.E.N.

N67-27025# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INCLINATION OF LOW-CARBON TRANSFORMER STEEL TO MAGNETIC AGING AND METHOD OF APPRAISING THIS INCLINATION

D. Ya. Vishnyakov and A. I. Paisov *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 31–35 refs (See N67-27021 14-17)

The characteristics in grade A steel produced by magnetic aging at 50°–100°C are reviewed and the mechanisms leading to the inclination are discussed. Changes in microstructure, separations, the presence of metastable iron nitride $Fe_{16}N_2$, and the effect of aging duration are covered. It is felt that the use of coercive force increases as a criterion requires considerably more investigation. Other conclusions are: (1) The cause of magnetic aging in the temperature range 50°–100°C is the separation and coalescence of metastable iron nitride. (2) The activation energy is 16,000±1500 cal/mole. N.E.N.

N67-27026# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ISOTHERMAL TREATMENT OF 13Kh12NVFMA STEEL

D. Ya. Vishnyakov, M. A. Figel'man, and G. A. Nazarov *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 37–44 (See N67-27021 14-17)

The possibility of using isothermal treatment of the chromium–nickel steel to reduce warping of thin shaped parts and to improve their workability by cutting was investigated. Specimens were prepared from steel rods of 40 mm diameter, and underwent normalization at 1000°C and tempering at 680°C. The mechanical properties and critical points were found. Determinations of residual austenite after various heat treatments indicate that the quantity decreases with an increase of the cooling rate during hardening. The kinetics of isothermal decomposition of supercooled austenite are discussed. It was concluded that: (1) The steel has greater strength after isothermal treatment. (2) Isothermal treatment ensures higher scale resistance of the steel. (3) The corrosion resistance depends mainly on the method of surface preparation. (4) The optimum conditions for cutting the steel are normal heat treatment with oil quenching while hardening, and isothermal treatment at 320°C. N.E.N.

N67-27027# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF HYDROGEN ON STRUCTURE AND PROPERTIES OF VT AND VT10 ALLOYS

V. A. Livanov, A. A. Bukhanova, and B. A. Kolachev *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 45–52 ref (See N67-27021 14-17)

The influence of hydrogen on the mechanical properties and microstructure of α- and β-titanium alloys is investigated. Data are presented on ultimate strength, yield point, elongation, toughness, tensile strength, and plastic properties. The changes in microstructure with different hydrogen contents are discussed. It was concluded that: (1) Hydrogen sharply lowers plastic properties of α-titanium alloy VT10 even when insignificant quantities are introduced. (2) Hydrogen decreases the plastic properties of $\alpha+\beta$ alloy VT8 to a lesser degree than of alloy VT10. N.E.N.

N67-27028# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF MAGNITUDE OF GRAIN ON HYDROGEN EMBRITTLEMENT OF TITANIUM AND ITS ALLOYS

V. A. Livanov, A. P. Bukhanova, and B. A. Kolachev *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 53–61 refs (See N67-27021 14-17)

Experimental procedures and data are reported for the embrittlement study in which specimens of commercially pure titanium were annealed in a vacuum at 700°, 900°, and 1100° C. Annealing at these temperatures produced structures with fine grains, average grains, and coarse grains, respectively. The dependence of mechanical and plastic properties on hydrogen content and annealing temperatures is discussed. It was concluded that: (1) Coarsely granular metal is more inclined to hydrogen embrittlement, and is caused by the diversified character of titanium hydride separation. (2) In finely-granular metal, the hydrides separate along grain boundaries in the form of compact, frequently shapeless separations. (3) In the alloys with coarse grains, the hydrides separate in the form of thin laminar plates, leading to a high concentration of stresses and very premature metal failure. N.E.N.

N67-27029# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF HYDROGEN ON THERMAL STABILITY OF ALLOY VT3-1

V. A. Livanov, A. A. Bukhanova, and B. A. Kolachev *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 63–71 refs (See N67-27021 14-17)

Isothermal annealing experiments were conducted on specimens of titanium alloys with 2% molybdenum, which stabilizes the β-phase. The influence of hydrogen on mechanical properties of the alloy after isothermal annealing at different temperatures, and the microstructure changes during the annealing are discussed in detail. Among the conclusions are: (1) The higher the annealing temperature, the more intense is the embrittlement. (2) Hydrogen lowers the thermal stability of the alloy, which is explained by the accelerated decomposition of β-phase and supersaturated α-solid solution. (3) Hydrogen lowers the thermal stability of alloy VT3-1 to a smaller degree than that of VT3. N.E.N.

N67-27030# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF OXYGEN AND HYDROGEN ON STRUCTURE AND PROPERTIES OF TITANIUM

V. R. Livanov, A. A. Bukhanova, and B. A. Kolachev *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 73–80 refs (See N67-27021 14-17)

The mechanical properties and microstructure of titanium with varying contents of hydrogen and oxygen are discussed. Data on the ultimate strength, yield point, elongation, and impact toughness are graphed. The grain size and separations of titanium hydride in the titanium saturated with oxygen and hydrogen are described. Among the results are: (1) With a small content of oxygen and hydrogen, hydrogen does not appreciably affect the strength of titanium, but does lower the plastic characteristics. (2) With a larger content of oxygen, hydrogen sharply lowers both the strength and plastic properties. (3) Oxygen sharply increases the ultimate strength and yield point when its content is not more than 0.5–0.7% by weight. (4) When both hydrogen and oxygen are present, separations of titanium hydride appear, and the separations are more dispersed with higher oxygen content. N.E.N.

N67-27031# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HYDROGEN EMBRITTLEMENT OF TITANIUM ALLOYS WITH ALUMINUM

V. A. Livanov, A. A. Bukhanova, and B. A. Kolachev *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 81–89 refs (See N67-27021 14-17)

Ingots of commercially pure titanium were smelted with aluminum and saturated with hydrogen to different concentrations, and the mechanical properties and microstructure were determined. Among the findings are: (1) Titanium hydrides appear with a greater concentration of hydrogen as the aluminum concentration is increased. (2) Aluminum essentially increases the strength properties and lowers the plastic properties. (3) The plastic characteristics are lowered intensely with additions of aluminum up to 3% and

again when the content is over 7.5%. (4) Aluminum decreases the inclination of titanium to hydrogen embrittlement, which is explained by an increase of the solubility of hydrogen in the α-solid solution and by the delay of the hydrogen diffusion process in the presence of aluminum. N.E.N.

N67-27032# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DISTRIBUTION OF ALLOYING COMPONENTS IN A TITANIUM INGOT, OBTAINED BY THE METHOD OF MELTING WITH A CONSUMABLE BATCH ELECTRODE

V. A. Livanov, M. I. Musatov, and B. A. Kolachev *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 91–104 ref (See N67-27021 14-17)

The problems encountered in obtaining a homogeneous distribution of alloying components in a titanium ingot are reviewed, and the use of a consumable electrode of standard shape is discussed. It is assumed that the processes of diffusion proceed sufficiently rapid in the liquid phase, so that the composition of the liquid phase is uniform throughout the volume. Equations are presented for the concentration and distribution of the components during the melting process. It is concluded that more equal distribution of the alloying components along the length and cross section is possible with the consumable batch electrode than with the arc melting method. N.E.N.

N67-27033# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATIONS OF CRYSTALLIZATION OF BINARY ALLOYS

A. A. Neustruyev *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 105–111 refs (See N67-27021 14-17)

The physical properties and processes during crystallization are reviewed, and formulas are developed for the crystallization rate between the liquidus and solidus points, for the portion of solid metal at a given temperature within that range, and for the spectral heat of crystallization. It is felt that these expressions can be used during analysis and calculations of castings. N.E.N.

N67-27034# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROSPECTS OF APPLICATION OF SILUMIN AS DEFORMABLE ALLOYS

V. I. Yelagin *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 113–119 refs (See N67-27021 14-17)

The behavior during shaping of the silumin alloy with 5% Si and 0.7% Mg was investigated to determine the dependence of mechanical properties of the sheets on heat treatment, and to establish the effect on the mechanical properties of additions of Mn, Cr, Mn and Cr, Zr, and Zn. Details are given on the hot and cold rolling into thin sheets, and on the aging. It was found that in the freshly hardened state all alloys are soft and plastic. All of the additions except zinc increased the ultimate strength and yield point after hardening in water and lowered the properties after the specimens were cooled in air. These additions are considered to accelerate the decomposition of the solid solution of silicon and magnesium in aluminum. In contrast, zinc delays the decomposition and increases the strength of air cooled specimen. Silumin with Mg and a high portion of Zn is recommended for weldable alloys. It is concluded that silumin alloys are good prospectives for deformable alloys because of the mechanical properties, casting properties, and low cost. N.E.N.

N67-27035# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE EFFECT OF THE COMPOSITION ON MECHANICAL PROPERTIES OF AVIAL, HARDENED WITH A LOWER COOLING RATE

V. I. Yelagin and Ye. V. Ekhina *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 121–131 refs (See N67-27021 14-17)

The effects on the mechanical properties of Mg and Si contents in aluminum alloy AV, of Mn in the ternary alloy Al–Mg–Si, and of Cu and Zn in Avial were investigated. Details are presented on the processing, and the data are graphed and tabulated. Among the conclusions are: (1) Sheet Avial with only Mg and Si has almost identical strengths after hardening in water and in air, and somewhat higher yield point after hardening in air than in water. (2) Manganese in Avials with or without Cu and Zn causes definite work hardening after water hardenening, and also causes weakening of the Avial after air hardening. (3) Avial without Mn is recommended for high strength characteristics. (4) The addition of Zn in Avial is recommended for obtaining high mechanical properties. N.E.N.

N67-27036# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF THE TYPE OF ADDITION MATERIAL DURING MANUAL ARGON ARC WELDING ON THE PROPERTIES OF JOINTS FROM ALLOY M40

O. S. Bochvar and K. S. Pokhodayev *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 133–140 (See N67-27021 14-17)

The structure, strength, and plasticity of welded joints under the influence of added materials were investigated. The rigid condition of suspended welding was taken, with subsequent forging of the fused seam. The data are discussed in detail, and include temperature range of crystallization and melting temperature, structure of the partial fusion zone of the base metal, hardness along the weld joint, structural heterogeneity of the joint, and bending with and without forging of the seam. Tables and graphs of the data are also presented. N.E.N.

N67-27037# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF CONDITIONS OF AUTOMATIC ARGON ARC WELDING ON PROPERTIES OF JOINTS FROM ALLOY M40

O. S. Bochvar and K. S. Pokhodayev *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 141–150 (See N67-27021 14-17)

The effects of added materials on the structure, strength, and plasticity of joints produced using the high strength thermally hardenable alloy are investigated. The strengths at different temperatures for hardened and aged and for hardened and cold worked joints were determined, along with ultimate strength, rupture strength, and bending angle. It was concluded that: (1) The base metal–fused metal alloying place, and the section of softening are weakened. (2) The weld joint strength at room temperature is 34–36 kg/mm^2. (3) At elevated temperatures the strength reaches that of non-cold-worked base material. (4) Joint plasticity makes possible complicated welded constructions. N.E.N.

N67-27038# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DISTINCTIVE FEATURES OF AGING OF ALUMINUM ALLOYS CONTAINING 5% Zn AND 1/2% Mg

K. S. Kirpichnikov *In its* Moscow. Aviation Technol. Inst. 13 Jan. 1967 p 151–160 refs (See N67-27021 14-17)

The initial stages of aging and prolonged aging were investigated, emphasizing the former. The phenomenon of slowing of the aging, decomposition rate of solid solution, and the effects of natural aging before and after artificial aging are discussed. Among the conclusions are: (1) The slowing of aging was noticed when alloys are subjected to high temperatures of artificial aging immediately after hardening. (2) The action of magnesium is shown in an increase of the spin distance. (3) In the initial stage of aging, the speed of the process is caused basically by the degree of supersaturation of the solid solution. (4) When alloys are

artificially aged after preliminary natural aging at room temperature, there was observed a return to the freshly hardened state. N.E.N.

N67-27039# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HIGH-SPEED CONDITIONS OF AGING OF ALUMINUM ALLOYS CONTAINING 5% Zn AND 1/2% Mg

K. S. Kirpichnikov *In its* Moscow, Aviation Technol. Inst. 13 Jan. 1967 p 161–167 ref (See N67-27021 14-17)

Two stage and multistage conditions for optimum high speed conditions of artificial aging were investigated, and the resulting mechanical properties were determined. Detailed data are graphed. The results indicate that: (1) Prolonged conditions of artificial aging can be replaced by high speed conditions of aging without a noticeable lowering of mechanical and corrosion properties. (2) The recommended conditions for two stage, high speed aging are holding at 100°C for 4 hours and heating to 150° and holding 7–9 hours. For the multistage process, the conditions are slow heating by steps up to 160°C for 3–4 hours and holding at 160°C for 7–9 hours. (3) Slow heating results in somewhat higher mechanical properties. (4) Microhardness is distributed irregularly through the grain. N.E.N.

N67-27173# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

THE THEORY OF THE CRITICAL SHEAR STRESS AND WORK HARDENING IN DISPERSION-HARDENED CRYSTALS

M. F. Ashby Dec. 1966 89 p refs Submitted for publication

(Contract Nonr-1866(27))

(TR-515; AD-647991) CFSTI: HC $3.00/MF $0.65

Part one describes models for the critical shear stress or yield stress of dispersion hardened alloys, by which we mean crystalline materials hardened by a dispersion of strong particles of a second phase; equations relating yield stress to the size and volume fraction of particles are derived, and compared with experimental results. It is shown that the stress required to bend a dislocation between particles frequently defines the flow stress. This stress is calculated, carefully avoiding many of the approximations inherent in older calculations. Part two describes work hardening in these alloys. The theory of Fisher, Hart, and Pry is able to describe work hardening of previously undeformed dispersion hardened crystals at small strains, (a few % elongation) but at larger strains it is less successful. A new theory of work hardening, applicable to larger strains is described. It is based on the fact that, if the particles do not deform plastically, and the interface between particle and matrix does not fracture, then secondary slip must occur locally round each particle when the crystal is deformed, even though the crystal may appear to deform by single slip. The density of secondary dislocations rises steeply with strain, and acts as a forest impeding the movement of primary glide dislocation. The theory predicts a relation between stress and strain which is in good agreement with experimental results. Fracture of the particle-matrix interface and the importance of the strength of this interface, are discussed. Author (TAB)

N67-27226*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF CLADDING ON EXTRUDABILITY AND PROPERTIES OF POWER-METALLURGY TUNGSTEN

Thomas B. Herbell, Charles A. Hoffman, and John W. Weeton Washington, NASA, May 1967 22 p refs

(NASA-TN-D-3941) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Powder-metallurgy tungsten both with and without 1/4-inch-thick molybdenum cladding was reduced 12:1 by extrusion in the temperature range 2400° to 4000°F. With cladding, extrusion was possible with preheat temperatures as low as 2400°F. Unclad billets could not be extruded with preheat temperatures less than 2800°F. Extrusion temperature and technique (clad or unclad) affected the as-extruded hardness, grain size, and room-temperature tensile strength. Tensile strengths at 3000° and 3500°F were not influenced by extrusion temperature or technique. There was no correlation between the elevated-temperature ductility and the post-test hardness or grain size. Author

N67-27236*# TRW Equipment Labs., Cleveland, Ohio. Materials Research and Development Dept.

ELEVATED TEMPERATURE FATIGUE OF TZC MOLYBDENUM ALLOY UNDER HIGH FREQUENCY AND HIGH VACUUM CONDITIONS

C. R. Honeycutt, T. F. Martin, J. C. Sawyer, and E. A. Steigerwald May 1967 28 p refs

(Contract NAS3-6010)

(NASA-CR-72241; Rept.-1) CFSTI: HC $3.00/MF $0.65 CSCL 11F

High frequency fatigue tests were conducted in a high-vacuum environment on recrystallized molybdenum-base alloy TZC at temperatures between 1800° and 2200°F. The results indicate that in this temperature range no well-defined endurance limit existed. Fatigue strengths at 2200°F and 10^9 cycles were as low as 16,000 psi. The application of a cyclic load to a statically loaded specimen produced a marked acceleration in the degree of specimen extension. This increase was characterized by a relatively rapid extension during the first thirty minutes of testing followed by a period of steady state creep which was approximately two orders of magnitude greater than the creep rate observed under a comparable static peak stress. Author

N67-27243# General Motors Corp., Indianapolis, Ind. Allison Div.

INVESTIGATION OF BIMETALLIC LIQUID METAL SYSTEMS Final Report

30 Sep. 1966 124 p refs

(Contract AT(30-1)-3643)

(GMAD-3643-8; EDR-4829) CFSTI: HC $3.00/MF $0.65

Material from bimetallic (AISI 316 SS and Cb-1%Zr) liquid metal (potassium) systems were examined and analyzed. These systems operated between 1200 and 1500°F for times up to 8000 hr. This investigation was conducted to better define design limits for these materials in long-life system applications. Results indicate that phase changes in the AISI 316 SS involve formation of complex carbides ($Cr_{23}C_6$) and chi phases. Stress rupture testing of loop-exposed specimens shows a decrease of about 65% in life at a given stress (or about 25% in stress value for a given life) after 3000 to 8000 hr of exposure. Exposing control specimens to 1500°F in air prior to stress rupture testing did not affect stress-rupture life. Exposure to liquid metal at 1350 and 1450°F caused a consistent, but not large, decrease in low-cycle fatigue life. Analyses of nitrogen gradients in the stainless steel containment showed that although nitrogen diffused into the loop through the high temperature AISI 316 SS, no area of outward diffusion of nitrogen through the stainless steel was found. Detailed chemical and metallurgical analyses of a loop which operated for 8000 hr was used for kinetics analysis of nitrogen, carbon, and oxygen transport. Author

N67-27250# Societa Ricerche Impianti Nucleari, Sallugia (Italy). Centro Ricerche Nucleari.

STUDY OF PHENOMENA CONNECTED WITH RADIATION DAMAGE IN IRON: INTERACTION BETWEEN DEFECTS INTRODUCED AND ATOMS IN INTERSTITIAL SOLUTION [STUDIO DEI FENOMENI CONNESSI CON IL DANNO DA RADIAZIONE NEL FERRO: INTERAZIONE FRA DIFETTI INTRODOTTI ED ATOMI IN SOLUZIONE INTERSTIZIALE]

M. Castagna, F. S. Rossi, and G. Szabo Miszenti 1967 13 p refs In ITALIAN Presented at Convegno sulla Chimica-Fisica dello Stato Solido e delle Superfici, Rome, 27 Feb.–1 Mar. 1967

(SORIN-108) CFSTI: HC $3.00/MF $0.65

The mechanism of neutron irradiation damage in iron reacting with interstitial solutions of atoms is discussed. The experimental results of carbon and nitrogen variable concentrations are analyzed, and a specific automatic measurement system introduced. Chemical and physical properties of the materials tested are briefly outlined. Transl. by R.Ll.

N67-27281*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.

MATERIALS FOR POTASSIUM LUBRICATED JOURNAL BEARINGS Quarterly Progress Report, 22 Apr.–22 Jul. 1966

R. G. Frank, ed. 22 Jul. 1966 135 p refs

(Contract NAS3-2534)

(NASA-CR-72239; QPR-13) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Friction and wear tests on candidate bearing material combinations are reported. Materials involved in the testing program were Mo–TZM alloy vs Carboloy 907, Carboloy 907 itself, Grade 7178 vs Mo–TZM alloy, and Mo–TZM alloy vs TiC+10%Nb. Tests were conducted at Rt, 400°, 800°, and 1200°F at pressures of 10^{-9} torr, and speeds of 800 SFM. Other friction and wear tests with these materials were successfully completed in liquid potassium at 400° and 800°F at speeds of 1,000 SFM. Chemical analyses of the potassium sampled before and after the tests were conducted indicated an oxygen content of less than 10 ppm. Results of compression tests of 13 candidate bearing materials are also reported. L.S.

N67-27305*# Hydronautics, Inc., Laurel, Md.

CAVITATION DAMAGE IN LIQUID METALS (POTASSIUM STUDIES) Technical Progress Report, 1 Nov.–31 Dec. 1966

S. L. Rudy, A. Thiruvengadam, and H. S. Preiser 3 Mar. 1967 34 p refs

(Contract NAS3-8506)

(NASA-CR-72232; TPR-607-3) CSCL 11F

Cavitation damage data are presented showing the rate of volume loss as a function of test duration for TZC, Cb-132M, and T-111, in liquid potassium at 600°F. The effect of potassium temperature from 400–1200°F on the steady-state zone rate of damage for each of the above metals is also given. Peak rates of damage for 316 stainless steel and TZC occur at 600°F whereas, Cb-132M and T-111 peak damage rates occur at 800°F. Selected mechanical data at elevated temperatures, are given for the metals tested. Author

N67-27310*# National Aeronautics and Space Administration, Washington, D. C.

RELATION BETWEEN MICROHARDNESS AND MICROBRITTLENESS OF REFRACTORY COMPOUNDS WITH THEIR ELECTRON STRUCTURE [O SVYAZI MIKROTVERDOSTI I MIKROKHRUPKOSTI TUGOPLAVKIKH SOYEDINENIY S IKH ELEKTRONNYM STROYENIYEM]

G. V. Samsonov and V. V. Stasovskaya May 1967 7 p refs Transl. into ENGLISH from Poroshkovaya Met. (Kiev), v. 6, no. 12 (48), Dec. 1966 p 95–99

(NASA-TT-F-10935) CSCL 11F

Measurements of the particle microhardness and microbrittleness in powdered TiC, ZrC, HfC, VC, NbC, TaC, $Cr_{22}C_6$, Cr_7C_3, Cr_3C_2, Mo_2C, WC, TiB_2, ZrB_2, HfB_2, VB_2, NbB_2, TaB_2, CrB_2, Mo_2B_5, and W_2B_5, using a PMT-3 hardness gage, are described. A brittleness index is introduced to characterize the brittle behavior of particles in the process of crushing. It is tentatively concluded that the hardness of these refractory materials increases with the statistical weight of stable sp^3 configurations of electrons in their atoms and decreases with increasing statistical weight of nonlocalized or weakly bonded electrons. Author

N67-27382# Joint Publications Research Service, Washington, D. C.

IDENTIFICATION SYMBOLS FOR IRON AND STEEL, NONFERROUS METALS, AND ALLOY PRODUCTS

6 Mar. 1967 35 p Transl. into ENGLISH of "Chung-hua Jen-min Kung-ho-kuo Kuo-chia" Peiping, 31 Dec. 1963 p 1–51

(JPRS-40131; TT-67-30777) CFSTI: HC $3.00

Standard identification symbols adopted by the metallurgical industry of the Chinese People's Republic for iron and steel, nonferrous metals and alloy products, are presented in tables. The lists are broken down into categories and groups. L.S.

N67-27420*# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.

MATERIALS DATA HANDBOOK: ALUMINIUM ALLOY 2014

John G. Sessler and Volker Weiss, ed. Apr. 1966 195 p refs

(Contract NAS8-11345)

(NASA-CR-84454) CFSTI: $3.00 CSCL 11F

A comprehensive summary of the materials property information available on the 2014 alloy is presented. The scope of the information includes physical and mechanical property data at cryogenic, ambient and elevated temperatures, supplemented with useful information in such areas as material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication, and joining techniques. Design data are presented, where available, and these data are complemented with information on the typical behavior of the alloy. Author

N67-27430*# Kaiser Aluminum and Chemical Corp., Spokane, Wash. Dept. of Metallurgical Research.

DEVELOPMENT OF A RAPID STRESS CORROSION TEST FOR ALUMINUM ALLOYS Annual Report, 1 Mar. 1966–1 Mar. 1967

N. J. Helfrich 15 Mar. 1967 64 p

(Contract NAS8-20285)

(NASA-CR-84441) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Various media were investigated for use in accelerated stress corrosion tests of aluminum alloys. In general, aqueous solutions of NaCl–K_2 Cr_2 O_7 were very effective in causing rapid short-transverse failures in the absence of excessive general surface corrosion. However, the stress corrosion performance of any one alloy and temper was dependent upon the solution pH and temperature. Neutral salt-(di)chromate solutions promoted rapid stress corrosion failures in susceptible tempers of 2024 and 2219. Neutral salt-(di)chromate solutions are relatively innocuous towards unstressed aluminum alloys. As such, they would be preferred to the more corrosive 3.5% NaCl solution employed in alternate immersion tests. Consideration has been given to modification of the neutral salt-(di)chromate solution with additions of strong oxidizing agents and use of buffered sodium chloride solutions in accelerated stress corrosion tests. Author

N67-27434*# IIT Research Inst., Chicago, Ill.

METAL CARBIDE–GRAPHITE COMPOSITES Quarterly Report

25 Apr. 1967 36 p refs

(Contract NASr-65(09))

(NASA-CR-84437; IITRI-66003-3; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Research in fabricating metal carbide–graphite composites by hot pressing at temperatures up to 3200°C, and in determining the physical and mechanical properties of these materials is reported. Experiments were conducted to more accurately establish hot pressing temperatures employing NbC–C eutectic formation as the indicator. Compositional studies were conducted, and include systems incorporating zirconium carbide and hafnium carbide in addition to the TaC–C and NbC–C systems. Property determinations were concerned with flexural and tensile strength, flexural creep at 2400°C, and thermal expansion up to 2300°C. C.T.C.

N67-27489# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.
THE CORROSION PROTECTION OF ANTIMONY OXIDE PRIMERS OVER AIRCRAFT METALS
Jack Ohr 9 Dec. 1966 4 p
(NAEC-AML-2532; AD-648228) CFSTI: HC $3.00/MF $0.65

Past and recent work covering antimony oxide primers was restudied, and from this, conclusions were drawn as to their practical merits in the corrosion prevention of modern military aircraft. TAB

N67-27506*# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
STRESS CORROSION CRACKING OF TITANIUM ALLOYS AT AMBIENT TEMPERATURE IN AQUEOUS SOLUTIONS Progress Report, Jun.–Aug. 1966
C. B. Gilpin Oct. 1966 26 p refs
(Contract NAS7-488)
(NASA-CR-84472; SM-49105-Q1) CFSTI: HC $3.00/MF $0.65 CSCL 11F

During this period a literature survey was made on subjects related to this problem area. The approach to experimental studies has been discussed. Preliminary electrochemical evaluations were conducted. Potentiostat curves for Ti–5Al–2.5Sn and Ti–6Al–4V in 3% NaCl, pH 6.5, were determined. Oxygenation was observed to shift the cathodic polarization curves in an electropositive direction, but did not greatly affect the anodic curves. Stress of 80% of the yield strength did not greatly affect the cathodic polarization but did reduce the anodic passivation for both alloys. Author

N67-27513*# Boeing Co., Seattle, Wash. Launch Systems Branch.
PROPERTIES OF 2219 ALUMINUM ALLOY STRESS RELIEVED PRIOR TO AGING
Robert R. Sands 28 Oct. 1966 6 p ref
(Contract NAS8-5608)
(NASA-CR-84481; T5-6539-76) CFSTI: $3.00 CSCL 11F

A study was conducted to determine the degree of tensile property degradation in 2219-T87 aluminum alloy when thermally stress relieved after solution treatment and prior to aging. The results showed that the tensile strength, yield strength, and elongation of the alloy were reduced 4.5, 6.6, and 6.0%, respectively, when stress relieved at 375°F for 3 hours prior to aging at 325°F for 24 hours. R.N.A.

N67-27516*# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
MATERIALS DATA HANDBOOK. TYPE 301 STAINLESS STEEL
John Sessler and Volker Weiss, ed. Jun. 1966 157 p refs
(Contract NAS8-11345)
(NASA-CR-84466) CFSTI: $3.00 CSCL 11F

A comprehensive summary of the materials property information presently available on the Type 301 stainless steel alloy is presented. The scope of the information includes physical and mechanical property data at cryogenic, ambient, and elevated temperatures, supplemented with useful information in such areas as material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication, and joining techniques. Design data are presented, where available, and these data are complemented with information on the typical behavior of the alloy. Information on the alloy is given in the form of tables and illustrations supplemented with descriptive text. Author

N67-27520*# Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
MATERIALS DATA HANDBOOK. ALUMINUM ALLOY 6061
John Sessler and Volker Walker, ed. Jul. 1966 154 p refs
(Contract NAS8-11345)
(NASA-CR-84480) CFSTI: $3.00 CSCL 11F

A comprehensive summary of the properties of aluminum alloy 6061 is presented. Information regarding the alloy's procurement; metallurgy; physical and mechanical properties; production; corrosion; environmental effects; surface; and joining properties, is given. Design data are also presented. L.S.

N67-27531*# Scientific Translation Service, La Canada, Calif.
LITERATURE SEARCH ON THE MANUFACTURE OF LAYERS OF MOLYBDENUM, TUNGSTEN, AND RHENIUM BY THERMAL DECOMPOSITION OF THEIR CARBONYLS OR REDUCTION OF VOLATILE HALIDES [LITERATURBERICHT UBER DIE HERSTELLUNG VON SCHICHTEN AUS MOLYBDAN, WOLFRAM UND RHENIUM DURCH RHERMISCHE ZERSETZUNG IHRER CARBONYLE ODER DURCH REDUKTION VON FLUECHTIGEN HALOGENIDEN]
M. Kadner May 1967 12 p refs Transl. into ENGLISH from Battelle Inst. Res. Rept. K66-09
(Contract NASw-1496)
(NASA-TT-F-10914) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Pure coatings of Mo, W, or Re are advantageously deposited from the vapors of the fluorides (W, Re) or the chlorides (Mo, W, Re) by reduction with hydrogen. Details, conditions, and results are discussed. Author

N67-27695 Polish Academy of Sciences, Warsaw.
THE INFLUENCE OF THE TEMPERATURE CYCLE PARAMETERS ON THE PLASTIC DEFORMATION OF ALUMINUM DURING THERMAL CYCLING [WPLYW CHARAKTERYSTYCZNYCH WIELKOSCI CYKLU TEMPERATUR NA WARTOSC ODKSZTALCENIA PLASTYCZNEGO W PROCESIE ZMECZENIA CIEPLNEGO ALUMINIUM]
F. Seyna 1966 28 p refs In POLISH; ENGLISH summary
(INR-766/XIV/PS)

Aluminium with a purity of 99.5% was tested by different temperature cycles to find the influence of the cycle parameters: the amplitude, the hold time at the maximum temperature, and the heating and cooling velocities. Analysis of plastic deformation on four typical temperature cycles was carried out. Author

N67-27701*# Avco Corp., Tulsa, Okla. Electronics Div.
A STUDY OF THE BLISTERING OF METAL SURFACES BY SOLAR SYSTEM IONS Quarterly Progress Report, 14 Jun.–14 Sep. 1966
James A. Cooley 14 Sep. 1966 35 p refs
(Contract NASw-1431)
(NASA-CR-84422; TR-66-G230-1; QPR-1) CSCL 11F

An electron microscope study of proton irradiated sample surfaces was conducted. Pitting of surface oxides may result from blistering followed by exfoliation. Orientation dependence of aluminum blistering is reported. A mass spectrometric study of hydrogen evolution from irradiated aluminum was conducted. No correlation was found between gas evolution and blistering. Author

N67-27722# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE APPLICATION OF A GENERALIZED MAXWELL EQUATION FOR THE THEORETICAL PROCESSING OF EXPERIMENTS ON SHORT RANGE DIRECT AND REVERSE CREEP OF GLASS PLASTICS
P. M. Ogibalov and I. M. Tiuneeva [1967] 5 p refs Transl. into ENGLISH from Vest. Mosk. Univ., Ser. 1: Mat. i Mekhan. (Moscow), no. 6, 1966 p 121–125

The discussion shows that for the direct and reverse short range creep of glass–plastics, a generalized Maxwell equation can be used to theoretically process the experimental results on the elastic after effect. R.N.A.

N67-27733# Bureau of Mines, Reno, Nev. Metallurgy Research Center.

ELECTROWINNING HIGH-PURITY NEODYMIUM, PRASEODYMIUM, AND DIDYMIUM METALS FROM THEIR OXIDES

E. Morrice and T. A. Henrie May 1967 15 p refs

(BM-RI-6957)

High-purity neodymium, praseodymium, and didymium (a cerium-free mixture of light rare-earth elements) were prepared by electrolysis of the oxides in a medium consisting of the respective rare-earth fluorides and lithium fluoride. The metals were electrodeposited in the liquid state and collected as nodules on a skull of frozen electrolyte. Cells were operated from 1,000° to 1,100°C. The requisite temperature was maintained by passing alternating and direct currents through the bath. Graphite was used for the anodes and tungsten for the cathode. The metal products contained <0.02 percent each carbon and oxygen and <0.025 percent tungsten as major impurities. Analysis of typical didymium metal nodules showed an approximately twofold enrichment in neodymium and praseodymium over their respective concentrations in the cell feed. The lanthanum content of the metal was about one-half its content in the oxide. Author

N67-27760# Joint Publications Research Service, Washington, D. C.

NEW STAINLESS STEELS FOR SURGICAL CUTTING INSTRUMENTS

Ye. Ya. Rauzina and Yu. A. Geller 21 Feb. 1967 10 p ref Transl. into ENGLISH from Med. Prom. SSSR (Moscow), no. 10, 1966 p 11–16

(JPRS-39976; TT-67-30623)

Combinations of carbon, chromium, and molybdenum content, with and without small amounts of other metals, were investigated for a stainless steel with increased hardness, wear resistance, and stability. The results are discussed in detail, and the data are graphed and tabulated. It was concluded that the steel with the most favorable qualities of hardness, range of tempering temperatures, wear resistance, cutting property, and corrosion resistance, is a steel composed of 1.2% carbon, 18% chromium, and 0.5% molybdenum. N.E.N.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N67-26603# Illinois Univ., Urbana. Coll. of Engineering.

CERAMIC ENGINEERING

In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 27–32 refs (See N67-26601 14-34)

Intensified research is reported in the fields of fibers, recrystallized glass, ceramic coatings, refractories, electrical ceramics, cements, and composites. Special properties of ceramic materials are being explored for use as semiconductors, nonmetallic magnets, and ferroelectrics. Attention is also directed toward anelasticity in uranium oxides, crystal growth, enthalpy changes, semiconducting vanadium phosphate glasses, and interfacial reactions between metals and ceramic molds. R.L.I.

N67-26789# Boston Insulated Wire and Cable Co., Mass.

SILICONE RUBBER SUITABLE FOR COAXIAL CABLE

Alfred Garshick Dec. 1966 16 p Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966

(AD-646540) CFSTI: HC $3.00/MF $0.65

Data and information are presented which demonstrate that coaxial cables can be made from silicone rubber and still have electrical performance comparable to that currently obtained from polyethylene and TFE fluorocarbon for a certain frequency range. Improvement in bending and installation of finished cables can be achieved since the inherent properties of the dielectric material become the cable properties. High temperature service, room temperature flexibility, excellent dielectric strength and low temperature flexibility are among the outstanding characteristics. It is also expected that high corona extinction voltages can be maintained under continued bending because of SRFs flexibility. Author (TAB)

N67-26797# Dainichi-Nippon Cables Ltd., Amagasaki (Japan).

DEGREE AND RATE OF CROSSLINKING OF CROSS LINKED POLYETHYLENE

Masaaki Okada Dec. 1966 15 p Presented at the 15th Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966

(AD-646531) CFSTI: HC $3.00/MF $0.65

Chemically crosslinked polyethylene has unique characteristics among crosslinked polymers used industrially. First, the number average molecular weight before crosslinking is very small; second, an appreciable amount of sol is contained in its crosslinked state. In order to obtain precise values of the crosslinkage density in such a material, it is necessary to develop a new technique. A new equation developed is proposed in this paper. It is based on the Flory–Rehner equation, but the number average molecular weight of the polymer prior to crosslinking is modified in terms of sol fraction. Another correction is made considering the distribution of crosslinkages between sol and gel. The new equation was proved to give reliable values over a wide range of crosslinkage density. It has also been proved that the equation is not apt to be grossly affected by a minor experimental error. The rate of crosslinking of polyethylene with dicumyl peroxide is a first order reaction controlled by the rate of thermal decomposition of the peroxide, which is verified by measurements of swelling and sol using the new equation and by measurements with the AGFA vulcameter. Author (TAB)

N67-26801# Furukawa Electric Co., Ltd., Tokyo (Japan).

UNDERWATER DEGRADATION OF POLYETHYLENE FOR WIRE INSULATION

Tsunemi Yoshida, Morikuni Hasebe, and Teruo Fukuda [1966] 26 p refs Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966

(AD-646545) CFSTI: HC $3.00/MF $0.65

Underwater degradation of polyethylene insulation is initiated with oxidation caused by oxygen dissolved in the water and then is propagated with the growth of cracks caused by water permeation. And to prevent degradation of polyethylene insulated wire, especially for underwater use, it is believed desirable to use a wire which consists of a tin-plated conductor and a coating of polyethylene, crosslinked if possible, containing optimum antioxident and minimum internal stresses. Author (TAB)

N67-26803# Phillips Petroleum Co., Bartlesville, Okla. Plastics Services Div.

A REVIEW OF POLYOLEFIN TEST REQUIREMENTS IN WIRE AND CABLE SPECIFICATIONS

R. J. Martinovich and C. F. Leslie [1966] 25 p Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966

(AD-646547) CFSTI: HC $3.00/MF $0.65

The primary purpose of the presentation is to review some of the test parameters currently being employed for polyolefin resins in the wire and cable industry and at the same time to emphasize the significance of each test in terms of the role it plays in the intended application. Although directed specifically toward

the wire and cable industry, some of these comments would also be applicable for other specifications in unrelated areas. Author (TAB)

N67-26804# Marine Engineering Lab., Annapolis, Md.
CABLE INSULATION THERMAL LIFE STUDIES
Ernest H. Halpern and Howard S. Ortgies [1966] 20 p refs Presented at the 15th Ann. Wire and Cable Symp., Atlantic City, 7–9 Dec. 1966
(AD-646548) CFSTI: HC $3.00/MF $0.65

In the thermal rating of magnet wires, the rate concept is taken into consideration. The thermal rating is based upon a 20,000 hour extrapolated life for magnet wires. With such a thermal-life rating it is possible to explore mechanisms of degradation of polymer insulation and at the same time upgrade polymeric insulation materials in thermal-life rating. Using a similar system of thermal-life rating which is summarized in Table I and Figure 1, (Ref. 1 and 2), thermal-life ratings may be determined for cables and wire. In some cases a thermal life rating will not be obtained in an expected temperature range. This may be indicative of a material incompatability such as an adhesive failure in a tape system. Such modifications in cable construction as paper separators can lead to a reduction in thermal-life rating. Topics included are: The thermal rating of H-film; The thermal-life rating of teflon; The thermal-life rating of ethylene propylene wires; Cut through on H-film data. TAB

N67-26806# Cooke Color and Chemical Co., Inc., Hackettstown, N. J.
THERMAL STABILITY OF CROSS-LINKED POLYETHYLENE
Allen C. Bluestein and John C. Henderson [1966] 8 p refs Presented at the 15th Wire and Cable Symp., Atlantic City, Dec. 1966
(AD-646549) CFSTI: HC $3.00/MF $0.65

The investigation demonstrated the fact that many different forms of polymerized trimethyl dihydro quinoline are available and that the 150C. oven aging characteristics of cross-linked polyethylene are sometimes affected by which of the various forms is employed. Thorough dispersion of the antioxidant is critically essential. Melting point, by itself is, in general, of little consequence and the volatile loss of antioxidant is of somewhat minor significance. Indications were shown that some parameters other than those discussed here are involved in the effectiveness of PTDQ as a high temperature antioxidant for cross-linked polyethylene. Although this work here was entirely on cross-linked polyethylene and polymerized trimethyl dihydroquinoline the principles involved should clearly apply to other polymer/antioxidant systems. Author (TAB)

N67-26833# Mound Lab., Miamisburg, Ohio.
DETERMINATION OF THE SHRINKAGE OF ADHESIVES DURING CURE
R. A. Fischbein and J. V. Dichiaro 20 Jan. 1967 11 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1361) CFSTI: HC $3.00/MF $0.65

The shrinkage of several adhesive formulations was determined by monitoring the change in the buoyancy of the adhesive in water. Shrinkages ranged from 2% to more than 6% for all formulations tested, with the exception of two methyl cyanoacrylate adhesives, which had much higher shrinkages. The determination of the total shrinkage of Eastman 910 adhesive under a variety of curing conditions is also described. Author (NSA)

N67-27122 European Atomic Energy Community, Petten (Netherlands). Structure Dept.
DISLOCATION-LOOPS IN NATURAL GRAPHITE SINGLE CRYSTALS REACTOR-IRRADIATED AT 1200°C
M. Heerschap Brussels, EURATOM, Mar. 1967 17 p
(EUR-3289.e)

Interstitial loops of a diameter of about 1000 Å decorated with small vacancy loops of a diameter of about 100 Å have been observed in graphite single crystals irradiated at 1200°C and are discussed. These loops are unsheared. In graphite single crystals irradiated at 1200°C and subsequently annealed at 2200°C separate interstitial and vacancy loops have been found. The vacancy loops are all sheared. The interstitial loops are unsheared except in some cases where they are sheared probably by the passage of a dislocation ribbon. Partial dislocations pinned by sheared interstitial loops have been observed. In some instances the loops have grown preferetially along dislocations or grain-boundaries. Author

N67-27217*# Aerojet-General Corp., Azusa, Calif. Von Karman Center.
MECHANICAL PROPERTIES OF EPOXY RESINS AND GLASS/EPOXY COMPOSITES AT CRYOGENIC TEMPERATURES
L. M. Soffer and R. Molho [1967] 68 p *Its* Contrib. No. 279
(Contract NAS3-6287)
(NASA-CR-84451) CFSTI: HC $3.00/MF $0.65 CSCL 11I

The mechanical properties of four modified-epoxy resin systems were investigated. Tensile properties (including strength, modulus, and elongation), notch toughness, impact strength, the coefficient of linear thermal contraction, and thermal-shock resistance were determined for cast-resin specimens at +75°, −320°, and −423°F. Interlaminar shear strengths were obtained for glass-filament-wound composite specimens at the three temperatures. The two systems with the best cryogenic properties were a hybrid-epoxy/polyurethane (Resin 4A) and a highly modified bisphenol-A epoxy (Resin 2). In choosing the optimum system, the same tests (except for notch toughness, impact strength, and short-span shear) were performed on filament-wound composite specimens at the three temperatures. In these tests, the performance of Resin 4A was better than, or at least comparable to, that of Resin 2. Author

N67-27228*# TRW Systems Group, Redondo Beach, Calif.
FOAM-IN-PLACE MATERIALS FOR HIGH VOLTAGE INSULATION IN A SPACE ENVIRONMENT
C. J. Holzbauer and R. J. Holbrook Apr. 1967 105 p refs
(Contract NAS3-8905)
(NASA-CR-72100; TRW-06378-6007-R000) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Based on the results of thermal aging and dielectric strength screening tests, two foam-in-place materials were selected for extensive evaluation to determine their usefulness as high voltage insulation in space environments. These materials, CPR 23 and Stafoam AA-600, were subjected to an applied voltage of 10,000 Vdc at 100°C for 3000 hours while exposed to a pressure of 10^{-5} torr or less. The permeability constant, ultraviolet radiation stability, vacuum weight loss, and mechanical properties also were determined. Results of the tests indicate that these foams may be used as insulation for direct current high potentials in high vacuum environments at moderate temperature. Author

N67-27261# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
FISSION GAS DIFFUSION IN PYROCARBON [DIFFUSIONE DI GAS DI FISSIONE IN PIROCARBONE]
B. Chinaglia and H. Walther 1967 17 p refs In ITALIAN Presented at Convegno sulla Chimica-Fisica dello Stato Solido e delle Superfici, Rome, 27 Feb.–1 Mar. 1967
(SORIN-106) CFSTI: HC $3.00/MF $0.65

Gas-cooled, high temperature, nuclear reactor combustion products (e.g., DRAGON reactor) are based on pyrocarbon combustion particles, and during the mechanism reaction a diffusion barrier is formed. A method, developed at SORIN Nuclear Research Center, measures the xenon diffusion coefficient. This method consists in injecting into an external uranium 235 target fission

particle fragments and, after an appropriate decay period, xenon 133 is measured during the heat treatment. This treatment increases the temperature logarithmically to study the diffusion coefficient. Technical results are reported also on structural differences of pyrocarbons. Transl. by R.Li.

N67-27313*# National Aeronautics and Space Administration, Washington, D. C.
ELASTOMERS AND SPACECRAFT [ELASTOMERES ET ENGINS SPATIAUX]
S. Kohn May 1967 23 p refs Transl. into ENGLISH from La Revue Generale du Caoutchouc et des Plastiques (France), v. 43, no. 7/8, 1966 p 957–967 Presented at the 2d European Meeting on Plastics and Rubber, 25 May 1966
(NASA-TT-F-10951; ONERA-TP-407) CSCL 11I

General data on the use of rubbers and resins as rocket propellants and in heat shields for space vehicles are reviewed with details on their physical and mechanical properties. Advantages of fiber-reinforced resins as compared to plain elastomers are discussed, with tabulations on the behavior of various elastomers and composite materials in space environment. An attempt is made to explain the mechanism of degradation of elastomers in the ablation of heat shields. Author

N67-27332# Union Carbide Nuclear Co., Oak Ridge, Tenn. Y-12 Plant.
CARBON BINDER MODIFICATIONS
G. B. Marrow, and A. J. Taylor 11 Jan. 1967 9 p refs Presented at Advanced Graphite Meeting, Los Alamos, N. Mex., 1–2 Mar. 1966
(Contract W-7405-ENG-26)
(Y-DA-1454; Conf-660335-1) CFSTI: HC$3.00/MF$0.65

Several graphitizable organics were combined with the resin in attempting to achieve copolymerization and a change in structure from the poorly crystallized, highly cross linked structure of nongraphitic carbon toward the well-ordered layer structure of graphite. Structural changes in the carbon were monitored by X-ray diffraction techniques. The results indicated that a complete and orderly transition occurs from the thermosetting and nongraphitizable resin to the thermoplastic and completely graphitizable pitches. NSA

N67-27342# Los Alamos Scientific Lab., N. Mex.
STUDY OF Ho_2C BY NEUTRON DIFFRACTION
G. L. Bacchella, P. Meriel, M. Pinot, and R. Lallement [1966] 6 p refs Transl. into ENGLISH from Bull. Soc. Franc. Mineral Cristal. (France), v. 89, 1966 p 226–228
(LA-TR-66-84) CFSTI: HC$3.00/MF$0.65

The rhombohedral structure of ordered Ho_2C was defined by neutron diffraction. It can be considered as a stratification, normally at the three-fold axis of a succession of layers of Ho–C–Ho–□.... The ordered magnetic structure is complex. Author (NSA)

N67-27522*# Scientific Translation Service, La Canada, Calif.
EFFECT OF PRE-STRESS ON THE STRENGTH OF ONE-DIMENSIONAL LAMINATES [INFLUENCE DE LA PRECONTRAINTE SUR LA RESISTANCE DES STRATIFIES UNIDIRECTIONNELS]
Michel Hediard May 1967 8 p refs Transl. into ENGLISH from Rech. Aerospatiale (France), no. 113, 1966 p 3–6
(Contract NASw-1496)
(NASA-TT-F-10909) CSCL 11I

The strength of laminates is relatively small when compared to glass fibers constituting its framework. Non-alignment of the fibers is one of the causes known for a long time. Another cause is the lack of stretching of some resins which leads to rupture. This has been shown by various authors and by O.N.E.R.A. scientists in particular. Applying pre-stresses to the laminate uni-directional framework during polymerization permits one to obtain a good alignment and the compression of the resin. This increases the possibility of adaptation to the deformations of the glass fibers, thus giving an appreciable increase of the strength of the uni-directional laminates whose glass fiber strength may reach 275 hb ° or more in tension. This improvement is a function of the applied pre-stresses. Author

N67-27680*# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
OPTIMIZATION OF THE PERFORMANCE OF A POLYURETHANE ADHESIVE SYSTEM OVER THE TEMPERATURE RANGE OF −423°F TO +200°F Annual Summary Report, 14 May–14 Feb. 1967
Herman Holland, Alfred H. McLeod, and Derril Steele 14 Mar. 1967 158 p refs
(Contract NAS8-11958)
(NASA-CR-84518) CSCL 11A

The bond performance of Narmco 7343 adhesive was evaluated during long-term storage (8 months) at high humidity and during short-term storage (28 days) at ambient conditions. Strength retention was greatest when siloxane primers were used in combination with siloxane integral blends. When similar polyurethane adhesives were blended with Narmco 7343 adhesive, the room temperature and +200°F strengths improved significantly, with no sacrifice of −320°F strength. A direct correlation among Shore D hardness, NCO content, and strength was established. Slower reacting amine curing agents were studied in an attempt to increase the pot life of the higher strength adhesives obtained when Narmco 7343 was blended with similar polyurethane adhesives. Narmco 7148 curing agent increased pot life about fivefold; when it was used in the form of a super-cooled liquid, pot life was increased about tenfold. Several bonding process changes were examined to establish their effect on bond strength. Small improvements were noted when a hand emulsifier was used to mix in the curing agent and when the degassing step was eliminated. Author

N67-27708*# University of Southern Calif., Los Angeles.
[GLASS TRANSITION PHENOMENA] Semiannual Status Report
R. A. Haldon, P. Rawlings, and W. J. Schell 1 Jun. 1967 4 p ref
(Grant NsG-343)
(NASA-CR-84427) CFSTI: HC$3.00 CSCL 11I

It is reported that length-temperature measurements on a polyalkyl methacrylate series, between −180°C and the glass temperature, were extended to longer chain polymers. A similar polyvinyl alkyl ether series was studied in the same temperature range, yielding similar results to those obtained for the methacrylates. Length-temperature measurements were made on a copolymer series of tetrafluorethylene (TFE) and 3,3,3 trifluoropropylene of TFE content 0, 19, 42, 64, and 100 mole percent, between −185°C and T_g. Also reported is that Furth's nearest neighbor distribution function, which is being explored as an alternate to the hole theory of the equation of state, was modified for the case of a simple monomer fluid. C.T.C.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N67-28486# RAND Corp., Santa Monica, Calif.
A PRACTICAL METHOD FOR DETERMINING GREEN'S FUNCTIONS USING HADAMARD'S VARIATIONAL FORMULA

H. H. Kagiwada and R. E. Kalaba Mar. 1967 15 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5286-PR; AD-648654) CFSTI: HC $3.00/MF $0.65

A method of computing Greens function as the solution of stable initial-value problems, using analog and digital computers to integrate large systems of ordinary differential equations subject to initial conditions. The solutions to many problems in mechanics, wave propagation, and mathematical physics can be represented in terms of Greens functions, but because of the difficulty of obtaining Greens functions either analytically or computationally, these representations have been viewed as theoretical rather than practical. The present method makes use of the work of Hadamard, in which the behavior of the Greens function is studied at a fixed point as a function of the length of the interval. Results of some numerical experiments are also included. TAB

N67-26509* Alabama Univ., University.
REVIEW OF QUARTERLY CONTRACTOR REPORT
31 Aug. 1966 26 p refs
(Contract NAS8-18000)
(NASA-CR-84155) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A mathematical discussion of the basic aspects of Markov chains is presented. Independent random variables, positive recurrences, transition probabilities, and rate of convergence are among the topics considered. N.E.N.

N67-26533*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
APPLICATION OF QUADRATURE FORMULAS TO ESTIMATION USING MOMENTS
Stephen J. Madden, Jr. *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 79–83 (See N67-26521 14-21)

To estimate probabilities in a nonparametric fashion similar to that given by Chebyshev's theorem, consideration is given to the problem of extracting certain information about a nondecreasing piecewise continuous function on the unit interval. The given moments are used to generate polynomials, and the quadrature formula is applied. To illustrate the procedure and its results, two simple functions were chosen for the continuous function and, using their first three moments, bounds were generated. Both functions are step functions and are displayed graphically with their computed bounds. R.Li.

N67-26556*# Rochester Univ., N. Y.
LYAPUNOV FUNCTIONS FROM AUXILIARY EXACT DIFFERENTIAL EQUATIONS
Edwin Kinnen and Chiou-shiun Chen Washington, NASA, May 1967 31 p refs
(Grant NsG-574)
(NASA-CR-799) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A Lyapunov function is the solution to an exact differential equation described in the phase space of the corresponding nonlinear differential equation. This idea is considered in reverse and the problem is discussed of finding an auxiliary exact differential equation from a given nonlinear differential equation such that its solution, obtained by integration, is a Lyapunov function for the original differential equation. The generalization afforded by this perspective is sufficiently broad to include published techniques for developing Lyapunov functions as reasonable attempts to solve the reformulated problem. It is shown that most of the Lyapunov functions appearing in the literature can be derived from various ways of developing this auxiliary differential equation. New methods for obtaining Lyapunov functions are also evident within the context of an auxiliary exact differential equation. Author

N67-26670# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Lab.
ASYMPTOTIC VARIANCES AND COVARIANCES OF MAXIMUM-LIKELIHOOD ESTIMATORS, FROM CENSORED SAMPLES, OF THE PARAMETERS OF A FOUR-PARAMETER GENERALIZED GAMMA POPULATION
H. Leon Harter Aug. 1966 155 p refs
(ARL-66-0158; AD-648045) CFSTI: HC $3.00/MF $0.65

Just how applicable the asymptotic variances and covariances are to estimates from samples of small or even moderate size is an open question. Conceptually, this question might be settled by a Monte Carlo study, but from a practical standpoint, any such study large enough to be conclusive would be ruled out by the excessive machine time required. Results of a small Monte Carlo study for the three-parameter Weibull population, reported by Harter and Moore, indicate that when three (or more) parameters, including the location parameter C, are being estimated simultaneously, the variances and the absolute values of the covariances are substantially in excess of the values given by the asymptotic formulas, even for sample size N as large as 100. The excess, however, appears to be proportional to N to the -2 and hence, for sufficiently large N, becomes negligible in comparison with the values given by the asymptotic formulas, which are proportional to N to the -1.
Author (TAB)

N67-26702# RAND Corp., Santa Monica, Calif.
A COMPACT STATISTICAL METHOD OF TOPOGRAPHIC REPRESENTATION
B. W. Boehm and J. E. Rieber Feb. 1967 64 p refs
(Contract F44620-67-C-0045)
(RM-5081-PR; AD-648487) CFSTI: HC $3.00/MF $0.65

An information regeneration method embodied in a FORTRAN program for storing topographic maps in a digital computer in compact form. A statistical model of the terrain is used. The major outlines of the topography are entered directly. When the altitude of any point is desired, the interstices are fleshed out by regeneration from the probability distribution of altitude variations, thus trading computer storage for execution time. Any desired degree of realism can be achieved at increased space/time cost. If realistic representation of a particular area is needed for detailed analyses of the influence of terrain, the direct representation methods described in RM-4636-PR are recommended. The statistical method is preferable for broad-brush analyses, in particular for terrain variation in a Monte Carlo analysis. Author (TAB)

N67-26777# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
NORMAL SOLVABILITY AND THE INDEX OF THE BOUNDARY-VALUE PROBLEM FOR A FIRST-ORDER ELLIPTIC SYSTEM ON AN ORIENTABLE SURFACE WITH A BOUNDARY
A. B. Yudanina 17 Nov. 1966 13 p refs Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 16, no. 5, 1964 p 704–709
(Contract NOw-62-0604-c)
(TG-230-T509; TT-67-61259; AD-648353) CFSTI: HC $3.00/MF $0.65

The author considers the limit problem for a first-order elliptic system on an orientable surface with a boundary. The Lopatinskii conditions are assumed. It is shown that the system is normally solvable and a formula for the index is obtained. The paper generalizes some results of Volpert. Author (TAB)

N67-26778# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON A BOUNDARY-VALUE PROBLEM
R. I. Anishchenko 8 Dec. 1966 23 p refs Transl. into ENGLISH from Sibirskiy Mat. Zh. (Moscow), v. 5, no. 3, 1964 p 481–492
(Contract NOw-62-0604-c)
(TG-230-T507; TT-67-61258; AD-648352) CFSTI: HC $3.00/MF $0.65

Glasses of the systems CaO.B2O3.V2O5 and CaO.P2O5.V2O5 have been prepared and their electrical properties studied. Under identical melting conditions the V5+/V4+ ratio for the borate glasses are much higher than that for the phosphates. The resistivity of the former are also much larger than the latter. However, for similar compositions and V5+/V4+ ratios, the borate glasses still have consistently higher resistivity. The network former thus has a real effect on the electrical properties of semiconducting oxide glasses. Author (TAB)

N67-26800# Columbia Univ., New York. Dept. of Mathematics.
ON RIGHT TRANSLATION IN TEICHMULLER'S SPACE
Fred Gardiner Feb. 1967 40p refs
(Contract Nonr-266(57))
(CU-30; AD-648992) CFSTI: HC$3.00/MF$0.65

An investigation was made to determine whether or not a certain map from universal Teichmuller space, T, to bounded operators in a certain Banach space was a homomorphism. It is found that this map is not homomorphic but, at the same time, precisely the extent to which it fails to be homomorphic. The other chief results of the paper are the theorems 1 through 5. Theorems 1 and 2 give two descriptions of right translation which are, in a sense, dual to each other. Theorem 3 is a local description of the derivative of right translation on the tangent bundle of Teichmuller space. Its importance is that it yields a corollary which gives new reproducing formulas and it makes possible theorem 5 which gives an explicit form of the operator 1/L(2, C to the mu power). Theorem 4 gives a geometric method of constructing inverses in Teichmuller space when points in T are viewed as quasicircles passing through 0, 1, and infinity. Namely, the inverse is given simply by complex conjugation. Author (TAB)

N67-26885# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TECHNIQUE OF SIMULTANEOUS DETERMINING OF ALL ROOTS OF AN ALGEBRAIC POLYNOMIAL
M. V. Rybashov *In its* Trans. of the All Union Conf.-Seminar on the Theory and Methods of Using Mathematical Models 13 Jan. 1967 p 417-425 refs (See N67-26841 14-08)

The determination of complex roots of an algebraic polynomial with real valued coefficients by analog computers, optimizers, and general purpose digital computers is considered. Author

N67-26882# RAND Corp., Santa Monica, Calif.
HOELDER CONDITIONS FOR GAUSSIAN PROCESSES WITH STATIONARY INCREMENTS
M. B. Marcus Mar. 1967 63 p refs
(P-3551; AD-648499) CFSTI: HC$3.00/MF$0.65

The study was motivated by the well-known results for Brownian motion, the law of the iterated logarithm and Paul Levys uniform Holder condition. Holder conditions, both uniform and local, are obtained for a wide class of separable, real-valued Gaussian processes with stationary increments. Relations between upper and lower Holder conditions are discussed. TAB

N67-26883# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
SUFFICIENT CONDITIONS FOR ASSOCIATION OF BINARY VARIABLES
D. W. Walkup Dec. 1966 22 p refs *Its* Mathematical Note No. 423
(D1-82-0444; AD-648147) CFSTI: HC$3.00/MF$0.65

In connection with studies of reliability of coherent binary systems, it has been suggested that a set of binary random variables be called associated if all pairs of binary nondecreasing functions of these variables have nonnegative covariance. In this note it is shown that there exists a unique smallest set A of pairs of binary nondecreasing functions on the variables such that nonnegative covariance for the pairs in A is necessary and sufficient condition for association of the variables. This set A is characterized and it is shown that its size increases rapidly with the number of variables. It is also shown that for four or more variables there exist pairs in a corresponding to coherent systems with no nontrivial modules, thus suggesting it is impossible to find an equivalent definition of association of binary random variables which makes material use of partitioning of the variables. Author (TAB)

N67-26898# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON THE CONTINUOUS DEPENDENCE OF THE SOLUTIONS OF DIFFERENTIAL EQUATIONS ON A PARAMETER
N. N. Petrov 18 Nov. 1966 18 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 7, 1964 p 29-36
(Contract NOw-62-0604-c)
(TG-230-T504; AD-648351) CFSTI: HC$3.00/MF$0.65

The author considers a system of differential equations dx/dt =x(t,x,lambda) and gives sufficient (and, under additional assumptions, also necessary) conditions for the continuous dependence of the solutions of this system on the parameter lambda. This is a continuation of an earlier paper of the author on the same subject. Author (TAB)

N67-26945# Texas A&M Univ., College Station. Inst. of Statistics.
VERIFICATION OF THE OPTIMALITY PROPERTIES OF AN ESTIMATION PROCEDURE BY MONTE CARLO TECHNIQUES
William B. Smith and R. R. Hocking Feb. 1967 11 p refs
(Grant DA-31-124-ARO(D)-282)
(AROD-4721-8-M; TR-7; AD-648878) CFSTI: HC $3.00/MF $0.65

The purpose of this paper is to illustrate the use of Monte Carlo generation of random samples from a Wishart distribution in the verification of the asymptotic properties of an estimation procedure. The procedure estimates the parameters of a multivariate normal distribution when some of the observation vectors are incomplete. TAB

N67-26946# Texas A&M Univ., College Station. Inst. of Statistics.
GENERATION OF RANDOM SAMPLES FROM A WISHART DISTRIBUTION
R. R. Hocking and William B. Smith Feb. 1967 9 p refs
(Grant DA-31-124-ARO(D)-282)
(AROD-4721-7-M; TR-6; AD-648877) CFSTI: HC $3.00/MF $0.65

The purpose of this paper is to provide a technique for simulating a sample covariance matrix. A need for such a technique will be shown in a subsequent paper where the simulation will be used to verify the large sample properties of an estimation procedure. TAB

N67-26956# Washington Univ., Seattle. Dept. of Mathematics.
THE COHOMOLOGY RING OF A SMOOTH MANIFOLD
James B. Carrell Mar. 1967 50 p refs
(Contract Nonr-477(15))
(TR-31; AD-648983) CFSTI: HC$3.00/MF$0.65

C. B. Allendorfer and J. Eells, Jr. have used pairs of singular differential forms to describe a cohomology theory alpha *(X,A) for any smooth paracompact manifold. This theory strengthens the de Rham theory since the coefficient group A may be taken to be any subring of the reals. Their main result is that alpha *(X,A) is canonically isomorphic to the Cech cohomology module H(X,A) of X with coefficients in A. The purpose of this paper is to describe

a natural cup product for alpha *(X,A) so that alpha *(X,A) becomes a ring canonically isomorphic with the Cech cohomology ring H(X,A). Author (TAB)

N67-26964# Yale Univ., New Haven, Conn. Statistics Dept.
TOPICS IN THE INVESTIGATION OF LINEAR RELATIONS FITTED BY THE METHOD OF LEAST SQUARES
Francis J. Anscombe Dec. 1966 50 p refs Submitted for publication
(Contract Nonr-609(52))
(TR-2; AD-645593) CFSTI: HC $3.00/MF $0.65

Various topics are reviewed: the effect of modern computers on statistical calculation; analysis by vector components rather than analysis merely of variance; 'stepwise regression'; testing goodness of fit by examining residuals. Possible alternatives to the method of least squares appropriate when the distribution of errors has long tails, and computation of the likelihood function resulting from a Pearson Type VII distribution of errors, are considered. Some of the methods discussed are illustrated by study of several sets of observations already well-known in the literature. Author (TAB)

N67-26973# California Univ., Berkeley. Operations Research Center.
OPTIMAL ASSIGNMENTS IN AN ORDERED SET. AN APPLICATION OF MATROID THEORY
David Gale Feb. 1967 8 p refs
(Contract Nonr-222(83))
(ORC-67-9; AD-648715) CFSTI: HC $3.00/MF $0.65

A certain set of jobs has been arranged in order of importance by some priority system and it is desired to fill the jobs from a pool of workers where each worker is qualified for some subset of the jobs. In general, it will not be possible to fill all of the jobs and the problem is therefore to choose the set of jobs to be filled in some optimal way. Roughly speaking, given all possible assignable sets of jobs one wishes to choose the one with highest priority. It is not clear, however, what this means as, for example, if the choice were between filling jobs 1, 4, 6 or 2, 3, 4, 5. The purpose of this note is to show that, in fact, there always does exist a best assignment. Author (TAB)

N67-27003# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
GENERALIZED FUNCTIONS. PART I: REPRESENTATION THEOREMS FOR SOME STANDARD FUNCTION SPACES—AN INTRODUCTION TO FUNCTIONAL ANALYSIS
John J. Benedetto Feb. 1966 383 p refs
(Contract Nonr-595(17); Grant NSF GP-4921)
(BN-431; AD-648383) CFSTI: HC $3.00/MF $0.65

The first part of the paper is devoted to the functional analysis necessary to study distributions. The distributions and applications of Fourier and Laplace transforms are dealt with comprehensively. An outline is given of research areas in distribution theory. Part three contains the theory of vector valued distributions from the point of view of nuclear spaces and topological tensor products. TAB

N67-27013# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PLANAR REPRESENTATIONS OF COMPLEX GRAPHS
Ronald M. Baecker 6 Feb. 1967 43 p refs
(Contract AF 19(628)-5167; ARPA Order 691)
(TN-1967-1; ESD-TR-67-61; AD-648133) CFSTI: HC $3.00/MF $0.65

The papers major topic is the problem of constructing good two-dimensional representations, using straight lines as edges, of complex, generally non-planar graphs. Two precise measures that correlate well with the subjective clarity of planar representations of randomly generated graphs are proposed. One is the number of edge intersections that do not correspond to graph vertices. The second measure, called infidelity, quantifies the degree to which the distance between pairs of vertices (in a particular metric in the plane) corresponds to their graph-theoretical distance from one another. Some experiments in graph representation, using the TX-2 computer on-line display, are described. Heavy emphasis is given the definition of the infidelity measure, the nature of its correlation with graph clarity, and some theorems which add to its characterization. Included is a discussion of heuristics for the simplification of a graph representation. In conclusion, there is presented a sketch of a model of a graph theory computer package that should be useful to a researcher or student of graph theory. Author (TAB)

N67-27073# North Carolina Univ., Chapel Hill. Statistics Dept.
ON INFINITELY DIVISIBLE LAWS AND A RENEWAL THEOREM FOR NON-NEGATIVE RANDOM VARIABLES
Walter L. Smith Feb. 1967 43 p refs *Its* Inst. of Statistics Mimeo Ser. No. 511
(Contract Nonr-855(09))
(AD-648577) CFSTI: HC $3.00/MF $0.65

Proof is presented for the following theorem: let (x sub n) be an infinite sequence of independent non-negative random variables such that, for some regularly varying non-decreasing function Lambda(n), with exponent L/Beta, 0< Beta< Infinity, as n approaches limit of infinity, p (x sub L+...+X sub N/Lambda(n) < or = x) approaches limit of k (x) at all continuity points of some d.f. k(x). Let a(x) be the function inverse to Lambda(n), let r(x) be any other regularly varying function of exponent Alpha>0. Then, if n(x) is the maximum k for which x sub 1+...+x sub k < or = x, it is proved that, as x approaches limit of infinity, where e r(n(x)) approximately equals I(Alph Beta) R(A(X)) and I(Alpha Beta) integral from 0 to infinity L/U to the Alpha Beta power d k(u) and this latter integral may diverge. Author (TAB)

N67-27105*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
COMPUTATION RESEARCH
In its Res. Lab. of Electron. 15 Apr. 1966 p 329 refs (See N67-27081 14-23)
(Contract DA-28-043-AMC-02536(E))

TOCS, an interpreter intended for use by the scientist with no prior programming experience, provides a set of operators to act on variable-length real and complex vectors created by the user. The feasibility of using TOCS is being investigated for possible application to the 360 computer. R.U.

N67-27133# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
CHIRAL ALGEBRA CONDITIONS ON πN AMPLITUDES
L. Maiani and G. Preparata 1 Mar. 1967 13 p refs
(ISS-67/6) CFSTI: HC $3.00/MF $0.65

It is shown that the local U(2)⊗U(2) chiral algebra and PCAC do not give any other sum rule for πN amplitudes apart from the Adler–Weisberger relation. By considering the commutators of an axial charge with an axial dipole we derive a sum rule involving weak axial production of pions, which, approximately evaluated, seems to be consistent with present data. Author

N67-27256 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Mulheim an der Ruhr (West Germany). Institut fuer Festigkeit.
STATISTICAL ESTIMATION METHODS FOR FATIGUE EXPERIMENTS—AN INTRODUCTION [STATISTISCHE SCHAETZVERFAHREN FUER DAUERFESTIGKEITS-VERSUCHE—EINE EINFUEHRUNG]
Werner Uhlmann (Wuerzberg Univ.) Feb. 1967 67 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-10; DVL-573)

After introducing fundamental ideas and notations, defect unbiased and median unbiased estimators for the quantiles of the survival distribution function are described, which do not depend on the form of the underlying distribution. Order statistics are used for setting up confidence intervals for the quantities. In the third section the Weibull distribution is derived from the theory of extreme values. It is proved that this distribution is uniquely determined except for three parameters. The following methods for estimating the parameters of the Weibull distribution are described: method of moments, graphical method, empirical straight line. Some examples complement the study, which is intended for a broad group of users. Author

N67-27377*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
LECTURE NOTES ON NONEXPANSIVE AND MONOTONE MAPPINGS IN BANACH SPACES
Zdzislaw Opial Jan. 1967 133 p refs *Its* Lecture Notes 67-1
(Grant NGR-40-002-015; Contract DA-31-124-ARO(D)-270)
(NASA-CR-84418) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A review is presented of some advanced concepts and theorems from functional analysis, centered around the compactness properties of bounded convex sets in reflexive Banach spaces and geometric properties of uniformly convex and strictly convex Banach spaces. Fundamental and well-known results are stated without proofs, but little-known technical lemmas and some novel results are provided with proofs. Topics covered include isometric mappings, common fixed points of commuting nonexpansive mappings, nonexpansive mappings and successive approximations, weak convergence of successive approximations, contractive approximations, monotone sets and mappings, coercive mappings, inequalities and surjectivity property of monotone mappings, nonexpansive and monotone mappings in Hilbert spaces, semimonotone and densely defined monotone mappings, and complex monotone mappings. C.T.C.

N67-27423*# Lockheed Missiles and Space Co., Huntsville, Ala.
SOLUTIONS OF SYSTEMS OF NONLINEAR EQUATIONS Final Report
Huntsville, Ala., 28 Oct. 1966 147 p refs
(Contract NAS8-20178)
(NASA-CR-84448; LMSC/HREC-A783333) CFSTI: HC $3.00/MF $0.65 CSCL 12A

This report presents the results of a study to develop a method and computer program for solving an arbitrary, simultaneous system of nonlinear algebraic and transcendental equations. A review of the literature and the theory regarding some particular methods are discussed. Computation schemes for digital computer facilities are emphasized, however, the feasibility and attractive features of hybrid computation schemes are also discussed. The final result of this study is a composite computer program which encompasses a "limited" spectrum of basically different numerical methods—gradient, minimization, and search techniques. Test results are included as a basis for comparison of the different methods. Author

N67-27538*# International Information, Inc., Philadelphia, Pa.
DEVICE FOR GENERATING ELLIPSES OVER AN ARBITRARY PAIR OF CONJUGATE DIAMETERS [VORRICHTUNG ZUR ERZEUGUNG VON ELLIPSEN UBER EINEM BELIEBIGEN PAAR KONJUGIERTER DURCHMESSER]
W. Trachsler May 1967 8 p Transl. into ENGLISH from Swiss Patent Office Master Patent No. 266659, 15 Feb. 1950
(Contract NASw-1499)
(NASA-TT-F-10947) CFSTI: HC $3.00 CSCL 12A

The subject of the invention is a device for generating ellipses over an arbitrary pair of conjugate diameters. The invention is characterized by a rotor having one adjustable marking unit and two adjustable rotary units. The latter units run in two transit paths in an orthogonal relationship to each other, so that the marking unit is continuously kept at such distances from the transit paths as are necessary for the execution of the ellipse. Author

N67-27575*# International Information, Inc., Philadelphia, Pa.
GAME APPROACH TO THE PROBLEM OF SELECTING OPTIMAL PARAMETERS OF A DYNAMIC SYSTEM [IGROVOY PODKHOD K ZADACHE VYBORA OPTIMAL NYKH PARAMETROV]
V. V. Tokarev and Yu. M. Fatkin Washington, NASA, Mar. 1967 13 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), no. 2, 1966 p 3–10
(Contract NASw-1449)
(NASA-TT-F-10738) CSCL 12A

The authors determine the parameters of a dynamic system, universal for a given class of maneuvers, assuming only that the boundaries for the range of possible maneuvers is known. The problem is formulated in terms of the theory of antagonistic games. An example is given of a solution applicable to the mechanics of space flight, i.e., the problem of the delivery of a payload by a limited-thrust ideal engine. The findings are compared with the results of other authors. Author

N67-27644*# Analytical Mechanics Associates, Westbury, N. Y.
CHEBYSHEV APPROXIMATIONS FOR THE STUMPFF SERIES OF ORDERS FOUR AND FIVE Interim Report
Herbert E. Salzer Jan. 1967 14 p refs
(Contract NAS5-9085)
(NASA-CR-84488; Rept.-67-2) CFSTI: HC $3.00/MF $0.65 CSCL 12A

This report gives the coefficients in the Chebyshev series for the four functions $f(x)=F_i(\pm x)$, where $i=4,5$ and $0\leq x\leq 1$; and the two functions $f(x)=F_i(x)$, where $i=4,5$ and $-1\leq x\leq 1$. With these coefficients, $f(x)$ can be found by a simple recurrence formula, without the need to calculate any Chebyshev polynomials. This form for $f(x)$ provides a single series which can be truncated at any term to meet varying needs in accuracy, and also avoids the considerably larger coefficients occurring in the explicit polynomial expressions for the approximations to $F_i(x)$. Author

N67-27645*# Oklahoma State Univ., Stillwater.
STATISTICAL METHODS AND SUBJECTIVE PROBABILITY Status Report
Leroy Folks [1967] 34 p refs
(Grant NGR 37-002-031)
(NASA-CR-84487) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Accomplishments are reported in a program aimed at using existing research in decision theory, subjective probability, Bayesian inference, and related areas to devise workable methods which use in a formal way the prior information. These accomplishments include a bibliography of subjective probability and Bayesian procedures, and regression analyses concerned with variance of posterior marginal distributions, prior distributions for positive slopes, and prior distributions for slopes known to be in an interval. C.T.C.

N67-27672*# Houston Univ., Tex.
ON THE ESTIMATION OF THE MATRIX OF A FINITE MARKOV PROCESS Semiannual Status Report, 1 Dec. 1966–31 May 1967
D. R. Taylor May 1967 8 p
(Grant NGR-44-005-037)
(NASA-CR-84514) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Efforts on estimating the transition matrix of a finite Markov process were directed toward the problem of determining which

nonnegative matrices are diagonally equivalent to stochastic or doubly stochastic matrices and that of determining the minimum permanent of the n×n doubly stochastic matrices. Research results in abelian groups are presented which are concerned with conditions under which continuous characters of closed subsemigroups of compact abelian semigroups admit extensions. The properties of some finite near-rings with identities were investigated. Some results are given of a study of the relationship between real valued continuous functions on a topological space and various properties such as normality and countable paracompactness. Investigation is continuing on the relationships between insertion theorems which allow continuous functions to be inserted between upper and lower semicontinuous functions and various paracompactness conditions. R.N.A.

N67-27675*# California Univ., Los Angeles. Dept. of Engineering.
APPROXIMATE CONTINUOUS NONLINEAR MINIMAL-VARIANCE FILTERING
Lawrence Schwartz Apr. 1967 84 p refs
(Grant NsG-237-62)
(NASA-CR-84517; Rept.-67-17B) CFSTI: HC $3.00/MF $0.65
CSCL 12A

Mathematical models of problems of white noise, stochastic integrals, and stochastic differential equations are presented. Approximate filter equations in present use are reviewed; and new valid filter equations for continuous nonlinear minimal variance filtering are derived. The results of a simulation program are presented. A bibliography of literature concerning the construction of these type of filter equations, is given. L.S.

N67-27677*# California Univ., Los Angeles. Dept. of Engineering.
IDENTIFICATION OF LINEAR STOCHASTIC DYNAMICAL SYSTEMS BY NONLINEAR WEIGHTING OF NOISY MEASUREMENTS
Walter Henry Kroy, Jr. Apr. 1967 106 p refs
(Grant NsG-237-62)
(NASA-CR-84509; Rept.-66-57B) CSCL 12A

Linear time invariance stochastic dynamical systems are identified for the class of systems where the plant is characterized by a scalar random parameter or by a matrix of random parameters having known distribution. The state of the system is observed under the effect of additive white gaussian noise having zero mean and known covariance. The white gaussian measurement noise is statistically independent of the white gaussian disturbing noise. The plant parameters are identified so that the mean square error between the plant parameter(s) and the estimate are minimized. The optimum estimate is the conditional mean or Bayes estimate. Discrete and continuous systems are examined. recursive polynomial estimators are described, and some of their asymptotic properties are discussed. Discrete and continuous recursive quadratic estimators are designed and extensions noted. The polynomial estimators are shown to be useful where noise levels are high and the observation time is small, and also have the advantage that their weighting functions are predetermined. R.N.A.

N67-27682 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Statik und Dynamik.
ARGMAT—A LANGUAGE FOR THE REVISION OF HYPERMATRICES [ARGMAT—EINE SPRACHE ZUR BEARBEITUNG VON HYPERMATRIZEN]
G. Meidell Larssen [1967] 30 p refs In GERMAN Presented at the 5th Space Tech. Symp., Stuttgart, 17–21 Oct. 1961

The derivation of ARGMAT from ALGOL is traced, followed by a non-formal description of the program. ARGMAT is based on two principles: (1) the return to the rectangular fields of ALGOL; and (2) the generalization of operators, which permits operation with rectangular fields. Designation of variables is explained. The program has eight types of constants: numbers, logic values, an undefined value, indicators, markers, chains, fields, and procedures. The application of single-digit, binary-digit, and double-digit operators to the mathematical processes is explained. The order of the operator hierarchy is shown. Expressions are explained, and definitions are given of skip expressions, designators, output expressions, and conditional expressions. The handling of input commands and block printouts is covered, and several programming examples are given. Transl. by K.W.

N67-27687# Technische Hochschule Stuttgart (West Germany).
EIGENREDUCTION OF COMPLEX MATRICES BY VON MISES' METHOD: A FORTRAN IV SUBROUTINE
P. C. Patton, O. E. Bronlund, and S. Kari-Appa Feb. 1966 23 p refs
(Rept.-25)

Von Mises' methods for real symmetric matrices and for complex matrices are presented. Details are then given on a Fortran IV subroutine, CMISES, whose purpose it is to find the eigenvectors and eigenvalues of a complex matrix. The iteration procedure involved is the von Mises method previously described. After the first 20 iterations, the rate of convergence for each five iterations is examined. If this rate is found by linear extrapolation to be such that the desired tolerance would not be reached in the remaining iterations, control is taken out of the iteration loop, a translation of origin takes place, and the loop is restored. Details on the strategy for shifting origin in the complex plane and on the strategy selected for CMISES are appended. L.E.W.

N67-27735# Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.
NUMERICAL INTEGRATION OF OSCILLATING FUNCTIONS HAVING A NON-LINEAR ARGUMENT
A. M. O. Smith 20 Feb. 1967 13 p refs *Its* Eng. Paper 3373

A procedure is described for numerical evaluation of integrals where f(x) and g(x) may be arbitrary functions having no restrictions except that they be sufficiently differentiable and single-valued. The method, which is a generalization of Filon's quadrature formula, is most useful when g(x) is a rapidly varying, nonlinear quantity. Three- and five-point formulas are presented. Author

N67-27758# Northwestern Univ., Evanston, Ill. Technological Inst.
ON THE NEWTON–RAPHSON METHOD
Adi Ben-Israel Sep. 1966 14 p refs Presented at Argonne Natl. Lab., Ill., 14 Jul. 1966 *Its* System Res. Mem. No. 162
(Grant NSF GP-5230)

The finite-dimensional results of the Newton–Raphson method for the solution of systems of equations are extended and applied to least squares problems. Various approaches to the Newton–Raphson methods of functional analysis are reviewed, and a bibliography is included. L.E.W.

N67-27776# Technische Hochschule Stuttgart (West Germany).
EIGENREDUCTION OF COMPLEX MATRICES BY THE A–P ALGORITHM: A FORTRAN IV PROGRAM
P. C. Patton and O. E. Bronlund Dec. 1966 29 p refs
(Rept.-32) CFSTI: HC $3.00/MF $0.65

The derivation of the A–P algorithm used for eigenreduction of complex normalizable matrices is outlined. New approximations are added to make the algorithm more useful. Fortran IV program subroutines (CAP, CAPIT, OFFMAX, AMAX, COFFDI, EQDIAG, and CMPY) used for finding the eigenvectors and eigenvalues of a complex matrix, are given. An example for a 3X3 non-normal complex matrix is presented. L.S.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N67-26492# National Meteorological Center, Suitland, Md.
TIME STEP VARIATIONS OF WINDS, HEIGHTS, AND TEMPERATURES IN THE NATIONAL METEOROLOGICAL CENTER PRIMITIVE EQUATION FORECAST MODEL Final Report
James E. McDonell and John E. Newell Dec. 1966 67 p refs
(Contract FA-66-WAI-110)
(SRDS-RD-66-82; AD-648638) CFSTI: HC$3.00/MF$0.65

Several series of consecutive values of the forecast fields are extracted for a subgrid of the hemispheric forecast grid. Statistics of the change in one time step of each field are computed at various pressure levels and at different periods during a 37 hour forecast. The purpose of the analysis is to determine whether the time step variations are small enough to permit the use of instantaneous values of the forecast quantities, or whether some type of time-smoothing is necessary. It is found that the winds and temperatures forecast by the model change from one time step to the next in such a manner that instantaneous values of these quantities may be used. The geostrophic wind derived from the forecast height field varies sufficiently during a period of one or two hours so that instantaneous values of this wind are not considered useful. The height field on isobaric surfaces undergoes a non-meteorological variation with a period of about three hours and an average amplitude of about fifteen meters. At some gridpoints the amplitude may be more than twice this value. In using the forecast heights consideration must therefore be given to the possible effects of this high frequency oscillation. Author (TAB)

N67-26741# Emmanuel Coll., Boston, Mass. Oriental Science Library.
WATER-VAPOR TRANSFER AND WATER BALANCE OVER EASTERN CHINA
Shu-ying Hsu Oct. 1966 32 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 29, no. 1, 1958 p 33–42
(Contract AF 19(628)-5073)
(EMM-65-29; AD-648156) CFSTI: HC$3.00/MF$0.65

Water-vapor transfer and water balance over eastern China are calculated using aerological sounding data of January and July 1956. It is shown that along with the seasonal variations of monsoon circulation, there is a marked difference in the transfer of water vapor between summer and winter. However, in both of these seasons the inflow of water vapor from the south is most significant. In comparison with the total transfer, eddy transport is generally less important. Maximum eddy transport occurs in central China, consistent with the translating path of the high in winter and the mean position of the polar front in summer. During July 1956, mainland China is shown to be a source of water vapor where the amount of evapotranspiration is larger than that of precipitation. Author (TAB)

N67-26894# Emmanuel Coll., Boston, Mass. Oriental Science Library.
ON THE EVALUATION OF TOTAL RADIATION BY CLIMATOLOGICAL METHODS
Tu-Ming Weng Oct. 1966 28 p refs Transl. into ENGLISH from Ch'i-Hsiang Hsueh-Pao (Peking), v. 34, no. 3, 1964 p 304–315
(Contract AF 19(628)-5073)
(EMM-66-82; AD-648687) CFSTI: HC$3.00/MF$0.65

Through a comparative discussion on the various proposed formulas for the evaluation of total radiation, the present study confirms the general validity of the expressions Q = Q0 f(S1, n) and Q = S0 phi(S1, n). The physical significance of the coefficient K in the Savinov-Angstrom formula and the related factors are discussed. A reason is offered to explain the fact that the sum of the percentage duration of sunshine and the average total cloud amount is not equal to 1 under conditions experienced in China. The annual variation of this entity is analyzed. The monthly and daily mean values of total radiation are computed from sunshine records at the various stations in China for the years 1958 - 1960. Empirical expressions for the direct radiation S and scattered radiation D are determined with a view to satisfying the requisite condition that Q = S + D. The accuracy in the determination of each entity in this expression is examined in the light of their functional dependence. Author (TAB)

N67-26900# Pennsylvania State Univ., University Park.
RESEARCH IN FOUR-DIMENSIONAL DIAGNOSIS OF CYCLONIC STORM CLOUD SYSTEMS
Edwin F. Danielsen Nov. 1966 63 p refs
(Contract AF 19(628)-4762)
(AFCRL-66-849; SR-2; AD-648587) CFSTI: HC $3.00/MF $0.65

The isentropic trajectory method which provides high resolution fields of vertical motions and the history of the air's three dimensional motion has been adapted for a high speed computer. Grid point values of the Montgomery Stream Function and pressure on the isentropic surface are read from hand analyses. All remaining operations are performed by the computer which include: an iterative solution of the balance equation, computations of the path of each trajectory from the Montgomery Stream Function and the balanced wind vectors, contouring of the stream function, isotachs and trajectories, computation and plotting of the vertical velocities. The method of solving the balance equation and the trajectory method are discussed. Comparisons between machine and hand computed trajectories and vertical motions are included for the November storm which was discussed in Scientific Report No. 1. A complete diagnosis of a March storm and a partial diagnosis of an April storm are also presented and discussed. The vertical velocities are well correlated with the clouds, precipitation regions and rates of cyclogenesis. TAB

N67-27011# Emmanuel Coll., Boston, Mass. Oriental Science Library.
THE CHARACTERISTICS OF LOW-LATITUDE FLOW PATTERNS OVER SOUTHEAST ASIA AND WESTERN PACIFIC FROM OCTOBER TO DECEMBER
Yi-ping Hsieh, Shou-jun Chen, and Xiao-lun Kuo Oct. 1966 13 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 35, no. 3, 1965 p 338–342
(Contract AF 19(628)-5073)
(EMM-66-88; AD-648052) CFSTI: HC$3.00/MF$0.65

Based on a study of the 1958 - 1959 data, the large-scale flow patterns over the Western Pacific at low latitudes in early winter may be classified into two types according to the vertical extent of the anticyclonic flow of the subtropical high, viz., the shallow subtropical high type and the deep subtropical high type. The former is characterized by a low zonal index at high latitudes and moderate development of easterly waves in the lower troposphere near the equator with the subtropical jet in phase with its mean position. The latter is characterized by a high zonal index at high latitudes and the presence of equatorial westerlies in the lower troposphere with the subtropical jet completely out of phase with its mean position. Typhoons may also form in the equatorial belt of convergence in the latter pattern. The sequential occurrence of these two types seems to follow a quasi-periodic oscillation with a period of about one month. Author (TAB)

N67-27074# Army Natick Labs., Mass. Earth Sciences Div.
CLIMATOLOGICAL CONDITIONS FAVORING OCCURRENCE OF HIGH TEMPERATURES AT YUMA PROVING GROUNDS, ARIZONA

Llewelyn Williams Jan. 1967 28 p refs
(TR-67-42-25; ES-28; AD-648016) CFSTI: HC $3.00/MF $0.65

Meteorological observations taken by the U.S. Army meteorological team at the Yuma Proving Ground, Arizona, provide some basic lower and upper limits to vertical solar and total sky radiation, ground-surface temperature, dewpoint temperature, wind speed, and wind direction during occurrence of high ambient air temperatures. However, even the more favorable combinations of these surface conditions do not provide an adequate explanation for occurrence of extreme temperatures at Yuma. The apparent key is the temperature of the air layer between 850 and 650 mbs. If this layer is warm, and a mechanism exists for bringing the air down to the surface, high ambient air temperatures exist. The mechanism may be the vertical exchange induced by the afternoon convection, or it may be the Fohn effect brought about by the synoptic pressure pattern. Author (TAB)

N67-27145# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
SYNOPTIC CONDITIONS OF CHARACTERISTIC WEATHER TYPES
V. N. Adamenko *In its* Glaciation of the Urals, No. 16 1966 p 77–91 (See N67-27141 14-13)

The conditions and the various combinations of meteorological elements making up concrete synoptic weather situations of the northern regions of the Urals are analyzed. Attention is focused on those characteristics of the weather which have an important effect on the processes of accumulation and melting of snow and ice. Types of weather and synoptic conditions during the cold and warm periods of the year are separately considered for this purpose. Two analytical methods are used: one is based on the calculation of averages and extremes of meteorological elements; the other is based on the observation of diurnal variations of meteorological elements. Situations from the years 1958 through 1961 are analyzed. Transl. by K.W.

N67-27201 Joint Publications Research Service, Washington, D. C.
RADAR IN METEOROLOGY
V. D. Stepanenko 29 Mar. 1967 177 p Transl. into ENGLISH from the book "Radiolokatsiya v Meteorologii" Leningrad, 1966 p 1–351
(JPRS-40459; TT-67-31104) CFSTI: $3.00

Radar techniques used for meteorology and weather forecasting programs are assessed. The technical parameters of radar stations are defined, and errors in radar observation of atmospheric formations and determination of cloud heights are identified. The principles for creating a system to obtain, process, collect, and distribute radar meteorological data are delineated. Also considered are the use of the Doppler effect for meteorological observations; airborne radar for detecting and bypassing showers and thunderstorms; determination of the water content of clouds and precipitation; fluctuation of echo signals from meteorological targets; and the technological characteristics of radar on a Sputnik. M.G.J.

N67-27317*# Travelers Research Center, Inc., Hartford, Conn.
THE PREDICTABILITY OF WIND AND VIRTUAL TEMPERATURE PROFILES FOR FLIGHT AND STATIC TEST OPERATIONS Final Report, 1 Jul. 1965–31 Mar. 1966
Keith W. Veigas, David B. Spiegler, John T. Ball, and Joseph P. Gerrity, Jr. 4 May 1967 115 p refs
(Contract NAS8-20234)
(NASA-CR-61170) CSCL 04B

The predictability of wind and virtual temperature profiles from the surface to 30 km for 0- to 72-hr forecast intervals has been evaluated. Meaningful forecast verification criteria were established for each of four NASA operational problem areas affected by winds and virtual temperatures: (a) launch and flight of an aerospace vehicle, (b) propagation of sound from missile firings (both static and real), (c) diffusion of toxic fields, and (d) design of missiles. Predictions of wind and virtual temperature profiles prepared by various methods were evaluated by the criteria established for the four problem areas. It was concluded that the state of the art was deficient in several areas of profile predictions considering the user's requirements. A Technique Development Plan was designed to guide the development of new prediction techniques and to tailor existing techniques specifically to meet the National Aeronautics Space Administration/Marshall Space Flight Center operational requirements. Author

N67-27553# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
IMPROVING VISIBILITY DURING PERIODS OF SUPERCOOLED FOG
J. R. Hicks Dec. 1966 41 p refs
(CRREL-TR-181; AD-648484) CFSTI: HC $3.00/MF $0.65

Six tests of dispersal systems using propane were conducted in Hanover, New Hampshire during winter 1964-65 and a like number in Greenland during summer 1965 mainly on supercooled fogs and in a few instances when air temperatures were within the lower 2 meters at or slightly above freezing. Propane was introduced into the fog as a liquid aerosol to induce spontaneous nucleation either by cooling or by clathrate reaction which may be important in fog modification. The tests show that liquid propane will improve visibility in fogs, is safe to use, and no standby time is needed. The system may be permanently installed with either radio or manually controlled valve units, and is inexpensive, a cost of $20/hr estimated to keep an airport approach zone clear of fog. Details of the individual tests conducted are given. The dispensing apparatus, propane flammability tests, and the theory of formation, growth, and precipitation of ice crystals, thermal reaction, and the clathrate concept are discussed. Author (TAB)

N67-27557# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
AERODYNAMIC NOISE SIMULATION IN SONIC FATIGUE FACILITY Technical Report, 15 Jan. 1964–15 Apr. 1965
Richard H. Lyon, Colin G. Gordon, Raya Stern, and Francis M. Wiener Wright-Patterson AFB, Ohio, Research and Technol. Div., Nov. 1966 73 p refs
(Contract AF 33(615)-1290)
(AFFDL-TR-66-112; Rept.-1349; AD-648022) CFSTI: HC $3.00/MF $0.65

The possibility of simulating a turbulent boundary-layer noise environment using the air-flow capability of the RTD Sonic Fatigue Facility is investigated. The philosophy is adopted that it is the mechanical power absorbed by the structure from the environment that is to be duplicated. Calculations are developed that allow the prediction of the mechanical power injected into a structure by a turbulent boundary layer (TBL), and by a turbulent wall-jet. The possibility of replacing the power injected by the TBL by using turbulent wall-jets impinging on a structural model of a section of a supersonic transport is studied. Results indicate that high-frequency excitation (above 1kHz) can be adequately simulated, but that the air-flow capabilities of the facility would be exceeded by an attempt to excite a structure as large as the one chosen by a set of wall-jets at lower frequencies. Author (TAB)

N67-27692# Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
THE MASS AND HEAT BUDGETS OF THE ATMOSPHERE OVER THE ANTARCTIC PLATEAU (WITH PARTICULAR REFERENCE TO SPRING)
F. A. Berson 1965 51 p refs
(TR-6) CFSTI: HC $3.00/MF $0.65

The intensity of a circulation cell, in terms of a mean toroidal circulation at the boundary, and average vertical velocity over the

major Antarctic plateau region, is calculated from all available wind data to 50 mb for a 40-day stratospheric spring warming period in 1960. Temperature and pressure-height data are used to determine the heat balance requirements of the overlying atmosphere as the sum of the cellular, horizontal transient-eddy and standing-eddy flux convergence of potential heat. The results are compared with earlier calculations of the mass and heat budget south of latitude 72°S on data to 100 mb for winter, spring, and summer periods. Unrealistically large net-radiational cooling rates obtain in the lower stratosphere in both spring periods only. They amount to much the same in both the 1958 and 1960 spring warming periods. Computation of vertical eddy flux of heat in the spring 1960 period showed that it cannot restore the heat balance in the lower stratosphere. It is concluded that upper boundary conditions in connection with the truncation of the atmosphere at 25 mb result in too high stratospheric subsidence rates and consequent radiational cooling rates. Author

N67-27712# Deutscher Wetterdienst, Offenbach am Main (West Germany).

CONSTRUCTION AND VALUE OF 24-HOUR HIGH LEVEL PROGNOSTIC CHARTS FOR APPLICATION TO BAROTROPIC PREDICTIONS [KONSTRUKTION UND GUETE VON 24STUENDIGEN HOEHENVORHERSAGE-KARTEN UNTER VERWENDUNG BAROTROPER VORHER-SAGEN]

Hans Klaus Meyer 1967 22 p refs In GERMAN; ENGLISH summary

(Rept.-103, Vol. 14)

A procedure of producing 24-hour prognostic charts for 850, 700, 300, and 200 mb in using barotropic 500 mb prognoses is described. For inferring the corresponding equations generally valid synoptic rules obtained by experience are applied. First, 50 300, and 200 mb charts for the period October 1964–February 1965 have been constructed manually according to derived equations. Later—within August to October 1966—another 50 charts were produced by computer for each level. The barotropic charts as well as the 300 mb prognostic charts were found to be better in quality than the corresponding hand-made product of the Analysis Center of the Deutscher Wetterdienst. The computer-produced 200 mb prognostic charts for which a comparison with those of the Analysis Center is not practicable were slightly better than the computer-produced 300-mb prognoses. The 700-mb hand-manufactured charts of the Analysis Center were—in an average of 50 charts—better than the corresponding computer-made ones. The computer-produced 850-mb prognostic charts were far inferior in quality to the prognostic charts of the remaining levels. Finally faults ascertained in the prognostic charts of an individual case as well as deviations of a general character are discussed in more detail. Author

N67-27717# Emmanuel Coll., Boston, Mass. Oriental Science Library.

A STUDY OF CERTAIN PROBLEMS RELATING TO SUBTROPICAL SYNOPTIC SYSTEMS IN CHINA DURING SUMMER

Shih-Yen Dao [1967] 12 p refs Transl. into ENGLISH from Chinese

(Contract AF 19(628)-5073)

(EMM-66-103(a); TT-67-61188; AD-648159) CFSTI: HC $3.00/MF $0.65

The monograph reviewed here presents a general summary of investigations by the authors during the past five years on the three main synoptic systems - typhoons, heavy rainstorms and the subtropical anticyclone in China during summer. Abstracts of the seven articles are included. TAB

N67-27720 Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON COMMUNIST CHINA: SCIENCE AND TECHNOLOGY, NO. 372

Hsiu-chi Chou, comp. 13 Apr. 1967 115 p refs Transl. into ENGLISH of the book "Nuan-Yun Chiang-Shui Wei-Wu-Li Chichih Ti Yen-Chiu" Peking, Sci. Press Aug. 1964 105 p

(JPRS-40617; TT-67-31261) CFSTI: HC $3.00/MF $0.65

The random process characteristics of cloud drop growth, and drop growth theory are emphasized in research on the microphysical mechanisms of rain from warm clouds. The theory includes the effects of fluctuating humidity fields; and collided combination growing processes of cloud drops in fluctuating concentration fields, turbulence fields, and vertical gas flow fields. Included are a discussion of cloud drop electrical charging mechanisms, and a general statistical theory on rainfall from warm clouds which presents a random process theorem applicable to rain from cold clouds. C.T.C.

N67-27767#

SEASONAL AND REGIONAL HAIL INTENSITY INDICES

Glenn E. Stout 13 Jan. 1967 23 p refs

(RR-36) CFSTI: HC $3.00/MF $0.65

Seasonal and regional hail intensity indices for wheat, corn, soybeans, and cotton calculated from average insurance loss costs, are presented for 21 midwestern states. The tables are useful in practical calculations for hail risk. L.S.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N67-26521*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

REVIEW OF NASA SPONSORED RESEARCH AT THE EXPERIMENTAL ASTRONOMY LABORATORY

Robert G. Stern ed. Jan. 1967 125 p refs

(Contract NAS12-501; Grants NsG-254-62; NGR-22-009-080; NGR-22-009-078)

(NASA-CR-84291; PR-3) CFSTI: HC $3.00/MF $0.65 CSCL 22C

CONTENTS:

1. INTRODUCTION R. G. Stern p 7–11 refs (See N67-26522 14-21)

2. A NEW SOLUTION TO LAMBERT'S PROBLEM W. K. Lim p 13–18 refs (See N67-26523 14-21)

3. STATISTICAL EVALUATION OF SIMPLIFIED MIDCOURSE GUIDANCE LAWS R. E. Curry p 19–23 refs (See N67-26524 14-21)

4. MANUAL ON-BOARD GUIDANCE FOR MANY-BODY INTERPLANETARY TRAJECTORIES N. A. Carlson p 25–30 refs (See N67-26525 14-21)

5. OPTIMUM NAVIGATION MEASUREMENTS J. H. Fegan p 31–38 (See N67-26526 14-21)

6. OPTIMAL MULTIPLE-IMPULSE ORBITAL RENDEZVOUS J. Prussing p 39–44 refs (See N67-26527 14-21)

7. OPTIMAL CONTROL IN THE PRESENCE OF MEASUREMENT UNCERTAINTIES J. Deyst p 45–49 (See N67-26528 14-21)

8. LINEAR PARAMETER OPTIMIZATION WITH QUADRATIC COST: A SUMMARY D. Rockwell p 51–55 (See N67-26529 14-21)

9. CLOSED LOOP "OPTIMAL" GUIDANCE EQUATIONS FOR SOFT LANDING C. F. Price p 57–63 refs (See N67-26530 14-21)

10. THE TWO-PLANET FLYBY PROBLEM R. E. Young p 65–70 ref (See N67-26531 14-21)

11. GYROCOMPASS SPACECRAFT ATTITUDE REFERENCE W. T. McDonald p 71–77 refs (See N67-26532 14-21)

12. APPLICATION OF QUADRATURE FORMULAS TO ESTIMATION USING MOMENTS S. J. Madden, Jr. p 79–83 (See N67-26533 14-21)

13. AN APPLICATION OF MATCHED ASYMPTOTIC EXPANSIONS TO HYPERVELOCITY FLIGHT MECHANICS R. F. Willes (AF Acad.) p 85–87 refs (See N67-26534 14-21)

14. THE ROTATION OF THE PLANET MERCURY C. Counselman p 89–93 refs (See N67-26535 14-21)

15. LOW LEVEL ACCELERATION MEASUREMENT APPARATUS S. Ezekiel p 95–103 ref (See N67-26536 14-21)

16. LONG-TERM LASER FREQUENCY STABILIZATION USING A MOLECULAR BEAM S. Ezekiel p 105–108 (See N67-26537 14-21)

17. GYRO AND ACCELEROMETER TEST PLATFORM J. T. Egan p 109–111 (See N67-26538 14-21) (See N67-26538 14-21)

N67-26524*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

STATISTICAL EVALUATION OF SIMPLIFIED MIDCOURSE GUIDANCE LAWS

R. E. Curry *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 19–23 refs (See N67-26521 14-21)

To obtain a quantitative measure of guidance law accuracies based on launch error statistics rather than a specific sampling of the launch errors, a statistical evaluation was made of simplified midcourse guidance laws. It was concluded that linearized explicit guidance schemes yield the same velocity correction for Type B reference (present position and velocity of Lambert conic to target). In addition, there is a velocity correction bias error inherent with the Type B reference trajectory. This bias error indicates that a maneuver should be made even if the nominal trajectory is being followed. The basic cause of such behavior is the neglect of the gradient of the perturbing accelerations and the choice of reference trajectory. R.Ll.

N67-26525*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

MANUAL ON-BOARD GUIDANCE FOR MANY-BODY INTERPLANETARY TRAJECTORIES

N. A. Carlson *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 25–30 refs (See N67-26521 14-21)

In an investigation of guidance techniques for interplanetary trajectories, approximate perturbation solutions valid over the midcourse and terminal portions of the trajectory are considered. The method of matched asymptotic expansions is applied. The three-body problem is examined first, the three bodies being the Sun, Mars, and the spacecraft. Equations are derived for spacecraft motion relative to the Sun and to Mars, and that of Mars relative to the Sun. It is noted that the Martian orbit is Keplerian in this context, and that the solution of either equation, given the Martian orbit, is sufficient to define the spacecraft trajectory. R.Ll.

N67-26526*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

OPTIMUM NAVIGATION MEASUREMENTS

John H. Fagan *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 31–38 (See N67-26521 14-21)

The establishment is considered of a general framework for the determination of navigation schedules which minimize estimation uncertainty for a fixed number of measurements. This study is a continuation of a previous work in which experimental results indicated that a grouping of sightings about certain optimum times, rather than a continuous distribution, resulted in more accurate position estimates for the same number of measurements. Two trajectories are investigated: a circular satellite orbit, and a hyperbolic free-fall re-entry. The state estimation in both cases is obtained by thirty-two star horizon sightings, accurate to one minute of arc. The combined effect of the assumption of two-body motion and the selection of a diagonal weighting matrix produces an inherent decoupling of the in- and out-of-plane error propagation in the problems considered. Given these conditions, it is established that an arrangement of sightings which preserves this decoupling always results in a better estimate. Therefore, instead of a unique sighting direction at each optimum sighting time, four different configurations are possible. R.Ll.

N67-26529*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

LINEAR PARAMETER OPTIMIZATION WITH QUADRATIC COST: A SUMMARY

Donald Rockwell *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 51–55 (See N67-26521 14-21)

In application to ballistic missile guidance coefficients, and to the solution of sets of linear algebraic equations, linear parameter optimization with quadratic cost is considered. The problem considered is that of choosing a set of unconstrained parameters, (u), to minimize a positive, definite, quadratic form in $x(u)$: $J(u) = x(u)^T A x(u)$, where x is an $nx1$ state vector that depends numerically on u, the $mx1$ control vector ($m \leq n$). The problem is solved approximately by assuming x to be nearly linear in u near the optimum point u^0. The result is essentially a reduction scheme for inverting $x^T A x_u$ while computing one column of x_u at each stage of the reduction. R.Ll.

N67-26530*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

CLOSED LOOP "OPTIMAL" GUIDANCE EQUATIONS FOR SOFT LANDING

Charles F. Price *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 57–63 refs (See N67-26521 14-21)

Previously developed guidance equations of a more general descent trajectory for a soft landing are extended to optimization techniques. A dynamical system of equations of motion which are approximately those of a body moving in a constant gravitational field, are derived for landing a vehicle on an atmosphereless planet. Final time t_f from a simplified optimal control problem is determined, and the mathematical steps required to generate thrust are listed. R.Ll.

N67-26532*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

GYROCOMPASS SPACECRAFT ATTITUDE REFERENCE

William T. McDonald *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 71–77 refs (See N67-26521 14-21)

In a study of spacecraft guidance and navigation, gyrocompass and star tracker attitude reference techniques are briefly summarized. It was seen that the gyrocompass always aligns with instantaneous orbital coordinates; the spacecraft can then be held in an orientation fixed relative to the reference body. This can only be accomplished with a star tracker system if there is a pole star for each phase of the interplanetary transfer orbit. The gyrocompass system reacts easily and automatically to changes in the orbit phase and reference body, and the gyrocompass is not restricted to fly preplanned reference trajectories. The gyrocompass appears to be a natural mechanization for low thrust trajectories in which the orbital plane and angular velocity change continuously and in which the thrust direction must be programmed relative to the

instantaneous orbital plane and the radius to the reference body. The required changes of the reference body are also easily accommodated. R.Li.

N67-26536*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
LOW LEVEL ACCELERATION MEASUREMENT APPARATUS
S. Ezekiel *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 95–103 ref (See N67-26521 14-21)

Low level acceleration, and its applications in the inertial guidance of low-thrust space vehicles, stabilization of test tables for sensitive inertial components, microseismology, and gravity research, are briefly reviewed for the LLAMA program. The low level acceleration measurement apparatus (LLAMA) consists of a linear, single-axis accelerometer using a small permanent magnet as a proof mass supported by magnetic forces inside a superconducting cylinder. Considered are the Meissner effect suspensions, displacement detection, and calibration techniques. R.Li.

N67-26548*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EVALUATION OF A MOVING-MAP INSTRUMENT DISPLAY IN LANDING APPROACHES WITH A HELICOPTER
William Gracey, Robert W. Sommer, and Don F. Tibbs Washington, NASA, May 1967 23 p refs
(NASA-TN-D-3986) CFSTI: HC $3.00/MF $0.65 CSCL 01D

An evaluation of an instrument display incorporating a moving-map instrument has been conducted in landing approach tests with a helicopter. The display consisted of the map instrument, a vertical situation indicator, and vertical scale instruments for the indication of airspeed, vertical speed, and height. The tests were conducted under simulated IFR (instrument flight rules) conditions along a 6° glide slope at approach speeds of 30 knots. Winds near the ground were about 8 knots. Tests of four maps with scales ranging from 100 to 1000 ft/in. (12 to 120 m/cm) showed that the pilots were able to adapt and to perform effectively with any of the scales tested. For the final part of the approach, however, their tracking performance was better with maps having large scales (on the order of 100 ft/in., or 12 m/cm). With two of the larger scale maps, approaches were flown to a 50-foot (15.24 m) breakout and visual slowdown to hover. The pilots were of the opinion that the map instrument provides a realistic display of course guidance information that can be interpreted easily and used with confidence. Author

N67-26614# Naval Research Lab., Washington, D. C.
SATELLITE CELESTIAL NAVIGATION
Robert B. Moore 27 Feb. 1967 22 p refs
(NRL-MR-1750; AD-648714) CFSTI: HC $3.00/MF $0.65

Satellite range and location data can be used to determine the location of an observer. This report discusses how the above may be done by using conventional celestial navigation methods. In lieu of sighting with a marine sextant or a bubble octant to obtain an observed altitude (Ho), a receiver and a phase-measuring technique can be used to determine a parametric range distance between the satellite and the observer. Satellite height and range parameters can be reduced to obtain the value for an observed virtual altitude (VHo), which is then used in the same manner as the standard Ho measurement. Author (TAB)

N67-26677# International Business Machines Corp., Owego, N. Y. Electronics Systems Center.
SYNERGISTIC NAVIGATION SYSTEM STUDY, PHASE I Final Report
Kenneth A. Klementis and Charles J. Standish 24 Oct. 1966 113 p refs
(Contract N00014-66-C0192)
(IBM-67-928-7; AD-648070) CFSTI: HC $3.00/MF $0.65

Phase I of the Synergistic Navigation Systems Study is a comparison analysis of the cost/effectiveness of various optimal filtering techniques for a Doppler-inertial navigation system with position-fixing. The costs are assessed in terms of program execution time and storage requirements imposed on the navigation computer. The effectiveness is assessed in terms of improvements in navigation accuracy, erection and alignment times, etc. The study demonstrated that an optimal Kalman filter, employing velocity and position-fix information, improves navigation accuracy over the accuracy of a conventional Doppler-inertial position-fix reset technique. These memory and processing-rate requirements can be brought within the acceptable implementation limits on an airborne digital computer. Prestored approximations to the optimal filter gains should yield navigation accuracy only slightly degraded from the optimal filter accuracy, but with far fewer program storage requirements. However, the prestored gain suboptimal filter is less flexible than the optimal filter. The accuracy of the prestored gain suboptimal filter could be degraded if the actual mission differs substantially from the mission for which the gains were precomputed. Author (TAB)

N67-26906# Lincoln Lab., Mass. Inst. of Tech., Lexington.
NAVIGATION WITH HIGH-ALTITUDE SATELLITES: A STUDY OF ERRORS IN POSITION DETERMINATION
Donald L. Snyder 6 Feb. 1967 41 p refs
(Contract AF 19(628)-5167)
(ESD-TR-67-60; TN-1967-11; AD-648828) CFSTI: HC $3.00/MF $0.65

An investigation was made of the accuracy with which the position of a receiver can be determined by use of a high-altitude satellite navigation system. The navigation system is modelled as a problem of nonlinear estimation in the presence of random disturbances. Equations are derived for describing positioning errors by using linearization and the Kalman-Bucy filtering equations. Author (TAB)

N67-27136 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany). Institut fuer Physik der Atmosphaere.
ABOUT A SUDDEN OUTBREAK OF FOG AT AN AIRPORT [UEBER EINEN BESONDERS GEFAEHRLICHEN NEBELEINBRUCH AN EINEM FLUGHAFEN]
F. Weber Feb. 1967 14 p refs In GERMAN; ENGLISH summary
(DVL-595; DLR-Mitt.-67-03)

A sudden outbreak of fog occurred at Munich–Riem Airport Dec. 15, 1965. The fog temporarily suspended air traffic. Ground based and radiosonde observations as well as visibility records are given. Author

N67-27184# Weather Bureau, Silver Spring, Md.
ANALYSIS AND MODIFICATION OF RVR EQUIPMENT FOR RVR VALUES 500 FEET AND ABOVE
Richard H. Waters and Richard R. Reynolds May 1966 182 p refs
(Contract FA-65-WAI-96)
(RD-66-34)

A rationale of the design criteria and choices of the present RVR system, reportings based on atmospheric transmittance measured over a 500 foot path, is presented. Modifications to existing equipment for low RVR reporting on three different schedules are described. Each of the three reporting modes are based on transmittance measurements over a 250 foot path. Reportings are from 600 feet to 200 and 500 foot increments, from 500 feet in 100 and 200 foot increments and from 500 feet in 100, 200 and 500 foot increments. Cost reductions that could be effected in the purchase of new equipment as a result of eliminating one or

two light settings, LS3 and LS4, are revealed. RVR computer modifications are discussed for an end-to-end transmissometer configuration. An operational analysis of the RVR computer system reveals three areas requiring improvement: additional circuitry is required to provide more reliable operation of the receiver-decoder over noisy signal lines; a design change is needed to eliminate the possibility of serious damage to the computer by erroneous insertion of interconnecting cables, and improved fabrication methods should be applied to the etched circuit relay board of the signal data converter. Author

N67-27187# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

OPERATIONAL EVALUATION OF DME CO-LOCATED WITH ILS FACILITIES Final Report

J. Levy, J. J. Cervi, and W. H. Hallenbeck Apr. 1967 58 p refs

(RD-66-98)

The operational utility and potential of DME co-located at Instrument Landing System (ILS) glide slope sites was evaluated at seven airports. Procedures based on DME at ILS were established and published. Questionnaires were developed and distributed to the pilot user groups and air traffic control personnel at the selected airports in order to obtain data based on user experience. The primary advantage of DME at ILS is to the pilot user group and provides benefits to all categories of pilots. Advantage to the air traffic control system is realized through more efficient utilization of air space by pilots and the availability of positive aircraft position for use in the control function. There was general consensus that DME could contribute to improve safety at any of the types of locations involved in the evaluation. It is concluded from the evaluation that the use of DME at ILS provides (1) positive distance information in the approach phase which supplies continuity for departure and enroute flight; (2) improved ILS approach procedures; (3) simplified cockpit procedures; and (4) a reduced pilot workload. It is recommended that the use of DME at ILS be expanded to other selected airports, particularly wherein siting of navigational aids is difficult or prohibitive due to mountainous terrain, expanses of water or other environmental factors. Author

N67-27188# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

DALLAS/FT. WORTH REGIONAL AIRPORT SIMULATION STUDY Final Report

Robert C. Conway Apr. 1967 66 p

(RD-67-5)

Simulation studies of a plan developed for the control of air traffic when a proposed regional airport is operational were conducted. The simulation was conducted using the model dynamic air traffic control simulators. Six different combinations of runway usage were tested in evaluating the plan. It was concluded that the plan as modified was capable of accommodating the 1980 traffic during a north or south traffic flow. However, during a northwest or southeast traffic flow this capability did not exist. It was also concluded the the location and associated runway alignment of the proposed regional airport and the proposed VORTACs were compatible to the overall terminal area IFR traffic flow. It was recommended that consideration be given to using the modified plan for the control of air traffic when the proposed regional airport is operational. Author

N67-27190# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

LOW-COST WEATHER-CONTOURING DEVICE Final Report

Anthony D. Bradley Nov. 1966 65 p refs

(CD-66-80)

A low-cost weather-contouring device was developed for use by the Air Route Traffic Control Center (ARTCC) high-altitude radar controller. The design and performance characteristics are given and the proposed electronic equipment modification are presented. It was concluded that the requirement to present contoured weather to the high-altitude controller positions can be met through the use of this low-cost device; and it was recommended that this operational capability be considered for introduction into the ARTCC as a modification to the RBDE-5 system. Author

N67-27192# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

VORTAC IDENTIFICATION LIGHT Final Report

Jack A. Muller Dec. 1966 23 p

(RD-66-89)

Flight tests were conducted to determine the feasibility of a VORTAC identification light. A standard 300-mm "V" coded beacon, a modified 300-mm "V" coded beacon and condenser-discharge lights were tested independently to determine the maximum range, under VFR, that positive identification of the VORTAC facility could be obtained. It was concluded that a modified 300-mm "V" coded beacon or strobeacons mounted on the VORTAC counterpoise, or a standard 300-mm "V" coded beacon or strobeacons mounted below the 12-foot counterpoise level and 30 feet from the counterpoise edge, provided excellent nighttime identification of the facility. Recommendations were made for additional field tests to determine the actual value of the VORTAC identification light to the airways navigation system, the cost to install a complete system at desired VOR facilities, the interference with aircraft and highway traffic, and the nuisance factor to inhabitants near VORTAC facilities. Author

N67-27193# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

AIRBORNE RADAR FOR HELICOPTER NAVIGATION Final Report

Harold D. Dunkel Sep. 1966 87 p

(RD-66-74)

A ground mapping airborne navigation radar BHR-3 operating in the 15.4 to 15.7 gc (Ku-band) was tested to provide data on the feasibility and usefulness of the system for helicopter navigation and to examine the suitability of radar enhancement devices. Additional tests planned to determine the effects of pilot fatigue and learning, aircraft altitude and limiting minimums of operation, and BHR-3 range scales on navigation with the ground mapping radar were canceled due to the unacceptable performance observed during the initial tests. Tests were performed with the BHR-3 system installed in an S-61L helicopter. Author

N67-27261*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

AN ANALYTICAL APPROACH TO THE DETERMINATION OF STELLAR FIELDS OF VIEW

Louis A. Kleiman and Raymond A. Arehart Washington, NASA, Jun. 1967 32 p refs

(NASA-TR-R-257) CFSTI: HC$3.00/MF$0.65 CSCL 17G

This paper describes a scheme to determine the size of the circular field of view that is both necessary and sufficient to include at least some specified number, n, of stars from a given set, independent of the orientation of the field within the celestial sphere. A geometrical proof of the scheme is presented, and all equations needed to effect the scheme are derived. The scheme is thus shown to be entirely analytical and to involve no assumptions concerning the distribution of the stars. Numerical results are presented in which the 1064 stars brighter than, or equal in brightness to, an apparent visual magnitude of +4.7 are considered.

The size and location of the necessary fields of view are tabulated as a function of limiting star brightness for n=1, n=2, and n=3. Finally, the meaning and importance of the data are discussed and related to star sensor technology. Author

N67-27299*# Boeing Co., Seattle, Wash.
STOP—A COMPUTER PROGRAM FOR SUPERSONIC TRANSPORT TRAJECTORY OPTIMIZATION
Lawrence H. Stein, Malcolm L. Matthews, and Joel W. Frank Washington, NASA, May 1967 355 p refs
(Contract NAS1-5293)
(NASA-CR-793) CFSTI: HC $3.00 CSCL 17G

An IBM 7094 digital computer program using the steepest ascent technique was developed for optimizing the flight path of a supersonic transport aircraft from the start of climb through cruise and descent. The program is sufficiently versatile for use with space boosters, ICBM's, reentry vehicles, scramjets, and vehicles with air-augmented rocket propulsion. The program incorporates a 3-D point mass simulation of a vehicle moving in relation to a spherical, rotating earth. The inverse-square law for gravity and 1962 U.S. standard atmosphere are used. The optimization is accomplished with an automatic step-size controller and with automatic control variable weighting matrices. Automatic plotting capability is included. Pitch angle, bank angle, wing sweep, and throttle setting are the control variables for the program. Inequality constraints are available on all control variables as well as on parameters affecting geopolitics, passenger comfort, structural loads, and engine operation. Geopolitical constraints include sonic boom overpressure and maximum and minimum altitude. Author

N67-27302*# Whittaker Corp., San Diego, Calif.
FIBROUS REINFORCEMENTS FOR SPACE APPLICATIONS
May 1967 42 p refs
(Contract NAS7-407)
(NASA-CR-796) CFSTI: $3.00 CSCL 11E

The properties of several polymeric materials obtained from a review of available data were defined and tabulated. Information on the polymeric material for both film and fiber forms, where available, was tabulated. Potential polymer classes for further development as materials for space applications have been identified. Author

N67-27467# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
AN INVESTIGATION OF SECTIONAL AERONAUTICAL CHARTS AND SERIES 200 CHARTS AS BRIEFING AIDS FOR A SIDE-LOOKING RADAR RECONNAISSANCE TASK
Final Report, Jan.–Jun. 1966
Don F. McKechnie Nov. 1966 19 p refs
(AMRL-TR-66-153; AD-648074) CFSTI: HC $3.00/MF $0.65

After appropriate training, 42 Air Force navigators were tested on a strip of side-looking radar imagery to study the effects on performance that circling targets on two types of aeronautical charts might produce. The imagery, at a scale of 1:130,000, moved down a back-lighted 14 by 14-inch screen at 16.8 inches per minute, corresponding to 1800 knots. The subjects task was to identify all airfields, dams, railroad yards, tank farms, and ammunition storage areas. The speed and accuracy of locating and identifying these targets under three conditions of briefing were assessed. The three conditions were (1) target list only (control group), (2) Series 200 Chart (1:200,000), target circled, and (3) Sectional Aeronautical Chart (1:500,000), targets circled. Fifty-five percent of the 24 targets were found when only the target list was given. Ninety-three percent of the 24 targets were found with the Series 200 Charts. Ninety-four percent of the targets were found with the group and one each for the chart groups. The mean travel distance before detecting a target increased when the charts were used. The mean false positive travel before responding was in every comparison greater than for real targets. This suggests that readily available charts, when annotated by circling the target, improve target detection performance tremendously. Author (TAB)

N67-27728# Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.
V/STOL APPROACH SYSTEM FLIGHT TESTS Final Report
Glen D. Adams Dec. 1966 71 p
(RD-66-95)

This report describes results obtained during helicopter flight tests on the Vertical/Short Takeoff-Landing (V/STOL) Approach System (VAPS). The system consists of a solid state microwave localizer and glide slope operating in the 15,000 MHz frequency region. All ground equipment is housed within a 5-foot-high radome, 4-1/2 feet in diameter. The localizer bearing and the parity slope angle can be readily changed by hand cracks at the ground station. The specified maximum fluctuation limits of ±0.5 degrees for the localizer and ±0.2 degrees for the glide slope were met. A CH-34C helicopter was operated approximately 80 hours on the VAPS. Fifteen hours of S-61N helicopter flight time were expended on approaches, with glide slope angle ranging from 3° to 60°. The conclusion is reached that during the S-61N helicopter approaches at angles greater than 20° it encountered VAPS equipment limitations (deficient guidance signals, and aerodynamic limitations) marginal control, roughness, and excessive descent rates. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N67-26543*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BEARING TORQUE AND FATIGUE LIFE STUDIES WITH SEVERAL LUBRICANTS FOR USE IN THE RANGE 500°F TO 700°F
Richard J. Parker, Eric N. Bamberger (GE, Cincinnati, Ohio), and Erwin V. Zaretsky Washington, NASA, May 1967 22 p refs
(NASA-TN-D-3948) CFSTI: HC $3.00/MF $0.65 CSCL 13I

Bearing torque decreased with increasing outer-race temperature up to 700°F for all seven lubricants. Increasing torque was observed with increased lubricant viscosity. Of four lubricants tested between 700° and 900°F outer-race temperature and lubricant-mist temperatures of 450° to 620°F, only the synthetic paraffinic oil with the antiwear additive showed no abrupt torque increase as the outer-race temperature was increased. Furthermore, increasing the lubricant-mist temperature had no effect on bearing torque. These results indicated that the lubricant mist had little cooling effect on the bearing. Apparent elastohydrodynamic lubrication, based on running track appearance, was indicated with all seven lubricants to outer-race temperatures of 700°F when sufficient lubricant flow was maintained. Fatigue tests were conducted at 600°F with a synthetic paraffinic oil plus an antiwear additive, a polyphenyl ether with an oxidation inhibitor, and a fluorocarbon with no additives. The synthetic paraffinic oil exhibited 10-percent fatigue lives 2 and 3 times greater than the lives obtained with the fluorocarbon and the polyphenyl ether lubricants, respectively. Author

N67-26550*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TRANSPORT STUDY OF THE REAL AND ADJOINT FLUX FOR NASA ZERO POWER REACTOR (ZPR-1)

Daniel Fieno. Washington, NASA, May 1967 89 p refs
(NASA-TN-D-3990) CFSTI: HC $3.00/MF $0.65 CSCL 18K

A one-dimensional, multigroup, multiregion S_n transport program has been developed for the IBM 7094 computer. This program has been used to calculate the real and adjoint fluxes for the NASA Zero Power Reactor (ZPR-1). In particular, the effect on the fluxes of a small spherical shell of cadmium located at the center of the reactor was determined. These calculated real and adjoint fluxes can be used to correct experimental reactivity determinations for materials within the cadmium shell. The effect of S_n order (n=2, 4, 6, or 8), elastic scattering order (P_0 or P_1), the number of spatial mesh intervals, and angular flux model representation (diamond or step) on the real and the adjoint fluxes at the center of the reactor and with the cadmium shell in place was determined. The S_4 transport calculations using a diamond model representation of the angular fluxes and using P_1 order elastic scattering were found to be adequate. Author

N67-26610# Illinois Univ., Urbana. Coll. of Engineering.
NUCLEAR ENGINEERING
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 147–156 refs
(See N67-26601 14-34)

Brief summaries are provided for the University of Illinois nuclear engineering program. Subdivisions of areas of interest include: reactor physics, neutron physics, and nuclear physics; reactor kinetics; plasma physics; shielding and radiation effects; environmental radiation control, radiation chemistry, and nuclear materials. R.LI.

N67-26712# RAND Corp., Santa Monica, Calif.
FAST BREEDER REACTORS AND THE SPREAD OF PLUTONIUM
V. Gilinsky Mar. 1967 58 p refs
(Contract F44620-67-C-0045)
(RM-5148-PR; AD-648464) CFSTI: HC $3.00/MF $0.65

Presented is a memorandum on the influence of the development and installation of fast breeder reactors on the future role of plutonium. The purpose of this memorandum is to alert people outside the nuclear industry, and in particular those professionally concerned with controlling the spread of nuclear weapons, to the coming industrial importance of plutonium which may have an important effect on the possibility of controlling the spread of nuclear weapons. Included are data on the breeding of fissionable material; fast breeder reactor programs in the United States and other countries; the role of fast breeders in nuclear power programs of the near future (1985), transition period (1985–2000), and the distant future (2000); the relative importance of uranium and plutonium; and technical aspects of fast breeder reactors and Pu-240 in fast breeder plutonium. S.C.W.

N67-26824# Battelle-Northwest, Richland, Wash. Plutonium Fuels Engineering Section.
FABRICATION COSTS FOR PLUTONIUM FUEL ELEMENTS. PART E: THE VARIATION IN FABRICATION COST WITH SOME FUEL DESIGN PARAMETERS
C. H. Bloomster Feb. 1967 22 p refs
(Contract AT(45-1)-1830)
(BNWL-131E) CFSTI: HC $3.00/MF $0.65

The effect on fabrication cost of some fuel design parameters is analyzed and a model permitting fabrication costs to be estimated for a wide variety of fuel designs is constructed. Variable fabrication costs for vibratory compacted PuO_2–UO_2 fuel elements for thermal reactors were analyzed and shown to vary in a consistent manner which may serve as a basis for predicting fabrication costs for other similar geometries. NSA

N67-26831# Sandia Corp., Albuquerque, N. Mex.
ROVER/PHOEBUS SCALED MODEL CHEMICAL EXPLOSIVE DESTRUCT TEST RESULTS
R. E. Berry Dec. 1966 55 p refs
(Contract AT(29-1)-789)
(SC-RR-66-589) CFSTI: HC $3.00/MF $0.65

The ROVER/PHOEBUS scaled model tests were performed to evaluate the safety aspects of nuclear power supplies being proposed for space application. Three tests were performed to provide base level or comparative data about the destruct event under controlled conditions. Data about the debris cloud shape, metallic parts distribution, and graphite particle size distribution were collected from these tests. Future testing to determine the effects of nonsimultaneous firing of the explosive charges, varying the explosive entry angle into the core, and destroying the model with the core heated to near reactor operating temperature were delayed pending a redirection of the program when the results from the control tests indicated that with the present explosive weight, perturbations would not be observable. During the delay period, the explosive destruct mode of disposal became less attractive, and the test program was canceled. Author (NSA)

N67-26981# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.
HIGH-TEMPERATURE MATERIALS PROGRAM. Progress Report, 1 Aug.–31 Oct. 1966
30 Dec. 1966 149 p
(Contract AT(40-1)-2847)
(GEMP-63; PR-63) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. HIGH-TEMPERATURE REACTOR MATERIALS RESEARCH J. B. Conway and P. N. Flagella p 11–29 refs (See N67-26982 14-22)

2. RADIATION EFFECTS ON FAST REACTOR CLADDING AND STRUCTURAL MATERIALS J. Moteff and F. Kingsbury p 31–58 refs (See N67-26983 14-22)

3. REFRACTORY-METAL ALLOY RESEARCH AND DEVELOPMENT E. S. Funston and C. O. Tarr p 59–69 refs (See N67-26984 14-17)

4. PHYSICAL METALLURGY OF REFRACTORY-METAL ALLOYS C. G. Collins p 71–74 (See N67-26985 14-17)

5. PHYSICO-CHEMICAL STUDIES OF Fe–Cr–Al-CLAD FUEL SYSTEMS H. S. Edwards and K. M. Bohlander p 77–81 refs (See N67-26986 14-22)

6. ADVANCED LONG-LIFE REACTOR FUEL CLADDING AND STRUCTURAL MATERIALS DEVELOPMENT J. F. Collins and F. C. Robertshaw p 83–93 refs (See N67-26987 14-22)

7. EFFECT OF RADIATION ON HEAT-RESISTANT METALS AND ALLOYS J. Moteff and J. P. Smith p 95–106 refs (See N67-26988 14-17)

8. EVALUATIONS OF THE PLASTIC FATIGUE PROPERTIES OF HEAT-RESISTANT ALLOYS J. Moteff and T. Slot p 107–110 refs (See N67-26989 14-17)

9. ADVANCED PRESSURE VESSEL MATERIALS F. C. Robertshaw p 111–113 refs (See N67-26990 14-17)

10. PHYSICO-CHEMICAL STUDIES OF CLAD UO_2 IN POTENTIAL MELTDOWN ENVIRONMENTS J. F. White p 115–128 refs (See N67-26991 14-22)

11. HIGH-TEMPERATURE THERMOCOUPLE AND ELECTRICAL MATERIALS RESEARCH E. S. Funston and W. C. Kuhlman p 129–135 refs (See N67-26992 14-22)

12. HIGH-TEMPERATURE RESEARCH ON CARBIDES FOR FUEL AND STRUCTURAL APPLICATIONS J. F. White and E. F. Juenke p 137–141 refs (See N67-26993 14-22)

N67-26982# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.
HIGH-TEMPERATURE REACTOR MATERIALS RESEARCH

J. B. Conway and P. N. Flegella *In its* High-Temp. Mater. Program 30 Dec. 1966 p 11–29 refs (See N67-26981 14-22)

Creep–rupture characteristics of various W–Re–Mo alloys were determined at 1600°C and 2200°C in hydrogen. Alloy compositions in the region of the phase boundary between solid–solution alloys and two-phase alloys have the least ductility (based on rupture strain) at both temperatures. Alloy compositions in the two-phase region have been found to be less creep resistant than the solid–solution alloys. Stress–rupture data for arc-cast Mo, W, and W–25Re from 1200° to 3000°C were analyzed using the Larson–Miller, Dorn, and Manson–Haferd parameters. For these high-temperature stress–rupture data, both the Larson–Miller and Manson–Haferd parameters yield the more effective correlations, based on a least squares analysis. Of the two, the Manson–Haferd results were the better. Enthalpy data for unalloyed Ta, Ta–10W, T-111, and T-222 were found to be essentially the same from 1000° to 2300°C. An analysis technique for correlating the thermal expansion characteristics of materials was identified which appears capable of assessing the consistency of experimental data. Fairly distinct linearity is obtained on a log–log plot of $\Delta L/L$ versus °C. Author (NSA)

N67-26983# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.

RADIATION EFFECTS ON FAST REACTOR CLADDING AND STRUCTURAL MATERIALS

J. Moteff and F. Kingsbury *In its* High-Temp. Mater. Program 30 Dec. 1966 p 31–58 refs (See N67-26981 14-22)

Annealing studies on the tensile and hardness properties at room temperature of Mo specimens irradiated at reactor ambient temperatures show that thermal hardening at 275°C is followed by a rapid recovery in the 800° to 1100°C range. The nil ductility in the irradiated specimens (1.2×10^{20} nvt, $E_n\geq1$ MeV) began to recover above 850°C and was fully restored at 1100°C. Annealing at 1200°C completely restored the yield and ultimate strengths and hardness to unirradiated control values. Author (NSA)

N67-26986# General Electric Co., Cincinnati, Ohio. Nuclea Technology Dept.

PHYSICO-CHEMICAL STUDIES OF Fe–Cr–Al-CLAD FUEL SYSTEMS

H. S. Edwards and K. M. Bohlander *In its* High-Temp. Mater. Program 30 Dec. 1966 p 77–81 refs (See N67-26981 14-22)

The objective of this program is to define and to understand reactions which can occur between oxidation-resistant Fe–Cr–Al alloys and UO_2 in the temperature region of 500° to 1200°C. In early attempts to apply the Fe–Cr–Al alloys as claddings for UO_2 or metal–UO_2 cermet cores, an undesirable result was the appearance of U as surface contamination. The tentative explanation was that reduction of UO_2 by Al produced U which diffused to the surface. The present program, aimed at quantitative understanding of the problem, has been divided into four parts: phase studies, diffusion studies, thermodynamic investigations, and fueled capsule tests. Author (NSA)

N67-26987# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.

ADVANCED LONG-LIFE REACTOR FUEL CLADDING AND STRUCTURAL MATERIALS DEVELOPMENT

J. F. Collins and F. C. Robertshaw *In its* High-Temp. Mater. Program 30 Dec. 1966 p 83–93 refs (See N67-26981 14-22)

Improved fuel element cladding and structural materials were developed and their properties of importance for fast breeder reactor applications defined. Selected Fe-, Fe–Cr-, and Cr-base alloys are being studied primarily as possible alternatives to austenitic stainless steel for the reactor fuel cladding and structure. Author (NSA)

N67-26991# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.

PHYSICO-CHEMICAL STUDIES OF CLAD UO_2 IN POTENTIAL MELTDOWN ENVIRONMENTS

J. P. White *In its* High-Temp. Mater. Program 30 Dec. 1966 p 115–128 refs (See N67-26981 14-22)

Clad melting tests of Zircaloy-4-clad UO_2 were made at 1850°C and 1900°C. Results show that there is no appreciable melting at the higher level when the thickness of the oxide scale is above 200 microns. Crystallographic analysis shows that a sample tested remained intact after testing at high temperatures, and showed a volume increase of about 1%. The electrical resistivity of Zircaloy-4 to 900°C and the tensile strength and ductility were measured at 1800°C. R.U.

N67-26992# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.

HIGH-TEMPERATURE THERMOCOUPLE AND ELECTRICAL MATERIALS RESEARCH

E. S. Funston and W. C. Kuhlman *In its* High-Temp. Mater. Program 30 Dec. 1966 p 129–135 refs (See N67-26981 14-22)

Transmutation effects produced a +13°C error at 600°C in a W versus W–25Re thermocouple and a −15°C error at 1900°C after exposure for 2 months in a 1.2×10^{14} nv thermal flux and 2.1×10^{13} nv fast flux. Studies to determine changes in the W–0.5 Os(at.%) versus W–25Re(wt%) thermocouple due to nuclear transmutations using synthesized alloys to represent transmuted compositions indicated that errors in this thermocouple could reach a maximum of approximately +50°C after 6 months in a 10^{14} nv thermal flux. Author (NSA)

N67-26993# General Electric Co., Cincinnati, Ohio. Nuclear Technology Dept.

HIGH-TEMPERATURE RESEARCH ON CARBIDES FOR FUEL AND STRUCTURAL APPLICATIONS

J. F. White and E. F. Juenke *In its* High-Temp. Mater. Program 30 Dec. 1966 p 137–141 refs (See N67-26981 14-22)

Measurements of carbon activity as a function of composition for uranium monocarbide were continued using the gas–solid equilibrium technique. The value of the carbon activity at 1500°C for $UC_{0.998}$ and $UC_{0.994}$ was 0.0500 and 0.0159 respectively. At 1700°C, the carbon activity for $UC_{0.985}$ was found to be 0.0331. The diffusion coefficients for carbon diffusion through rhenium at 1500°C and 2300°C were found to be 2.3×10^{-8} cm^2/sec and 1.2×10^{-6} cm^2/sec, respectively. Author (NSA)

N67-26999 European Atomic Energy Community, Ispra (Italy). Reactor Physics Dept.

PROCOPE—A CODE TO EVALUATE COLLISION PROBABILITIES IN PIN CLUSTERS AND INFINITE ROD LATTICES

C. Daolio Brussels, Apr. 1967 108 p
(EUR-3296.e)

The computer code PROCOPE, written in Fortran II for the IBM 7090, evaluates directional collision probabilities (normal and reduced) in pin clusters or infinite rod lattices. Author

N67-27059# Argonne National Lab., Ill.

VANADIUM ALLOY SCREENING STUDIES AND FABRICATION OF V-15w/oTi-7.5w/oCr TUBING FOR NUCLEAR FUEL CLADDING

W. C. Kramer, W. R. Burt, Jr., F. J. Karasek, J. E. Flinn, and R. M. Mayfield Aug. 1966 60 p refs
(Contract W-31-109-ENG-38)
(ANL-7208) CFSTI: HC$3.00/MF$0.65

Based on results of screening tests involving a number of alloys, the V-15 wt % Ti-7.5 wt % Cr alloy emerged as a

promising cladding candidate for Na-cooled fast reactors. "Scale-up" or pilot-plant production technology is presented for this alloy. Consolidation involved consumable arc-melting of compacted electrodes, followed by arc-remelting. The double-melted ingots were broken down by extrusion, followed by re-extrusion into rod, sheet-bar, and tube-blanks. Rod and sheet products were easily cold-rolled to finished sizes. Extruded tube-blanks were processed by swaging, tube-reducing, and drawing. Some early processing problems were solved, and high yields were realized in the production of reactor-grade tubing. Results of annealing studies and property tests are presented and discussed. Author (NSA)

N67-27060 Minnesota Mining and Mfg. Co., St. Paul, Minn. Electrical Products Group.
SNAP-21 PROGRAM, PHASE II: DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM Quarterly Report, 1 Oct.–31 Dec. 1966
J. F. X. Weinig Feb. 1967 156 p
(Contract AT(30-1)-3691)
(MMM-3691-12; QR-2) CFSTI: HC $3.00/MF $0.65

A study of the dynamic loads that a SNAP-21 system will experience during its operational life was conducted. A structural design analysis was made and verified by dynamic testing. These tests included conditions which could occur during assembly and handling, transportation, implantment, and recovery of the system. The effects of the dynamic loads were determined, and design modifications specified. Plans for the nondestructive (ultrasonic) testing of the SNAP-21 fuel capsule are outlined. Progress in component design and development is reported. Cold end heat transfer tests for the thermoelectric generator were begun. Thermopile drawings for these generators were released. The insulation system received special attention such as: offgassing tests, weld development, getter retainer analysis and testing, and seal-off device design work. NSA

N67-27137# Kernforschungsanlage, Juelich (West Germany).
EXPERIMENTAL STUDIES ON THE CREEP BEHAVIOR OF A PILE OF SPHERES WITH REGARD TO FUEL ELEMENT CIRCULATION IN THE CORE OF A PEBBLE-BED REACTOR [EXPERIMENTELLE UNTERSUCHUNGEN ZUM FLIESSVERHALTEN EINES KUGELHAUFENS IM HINBLICK AUF DEN BRENNELEMENTKREISLAUF IM CORE EINES KUGELHAUFENREAKTORS]
D. Bedenig Brussels, EURATOM, Apr. 1967 103 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-003-63-1 RGAD)
(EUR-3284.d) CFSTI: HC $3.00/MF $0.65

This pebble bed reactor study presents measurement methods for the creep behavior of fuel spheres; evaluated were graphite, steel, glass, and scoop models by their flow characteristics through orifices and by fluidization spectra. A computer program was developed for the flow stream model that determines velocity distribution and flow profiles for a pile of fuel spheres. Theoretical and experimental agreement established the validity of the flow stream model for core-volume flow calculations. Transl. by G.G.

N67-27138# European Atomic Energy Community, Brussels, (Belgium).
AN UNSOLVED PROBLEM IN METALLURGY: STRESS-RELIEF ANNEALING OF NUCLEAR REACTOR VESSELS [UN PROBLEME METALLURGIQUE NON RESOLU: LE RECUIT DE DETENTE DES CUVES POUR REACTEURS NUCLEAIRES]
J. Sebille Feb. 1967 23 p refs In FRENCH; ENGLISH summary
Presented at the Panel of Experts on Recurring Inspection of Nucl. Reactor Pressure Vessels, Pilsen, Czech. 3–7 Oct. 1966
(EUR-3317.f) CFSTI: HC $3.00/MF $0.65

This study shows that the metallurgical aspects of stress-relief annealing call for a great deal of supplementary research, the results of which to data demonstrate both its advisability and importance from the standpoint of vessel properties and safety. Author

N67-27195 Kernforschungsanlage, Juelich (West Germany). Institut fuer Chemische Technologie.
RADIOCHEMICAL DETERMINATION OF FISSION PRODUCT RELEASED FROM COATED FUEL PARTICLES AFTER IN-PILE IRRADIATION [RADIOCHEMISCHE BESTIMMUNG DER SPALTPRODUKT-ABGABE VON BESCHICHTETEN BRENNSTOFFPARTIKELN NACH DER REAKTORBESTRAHLUNG]
H. J. Riedel 1967 14 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-003-63-1 RGAD)
(EUR-3271.d) Available from Office Central de Vente des Publ. des Communautes Europeennes, Luxembourg: 3.20 DM

An important question in the use of coated particles as nuclear fuel carriers in high-temperature gas-cooled reactors is the extent to which gaseous and non-gaseous fission products penetrate the fuel coating. The layer of pyrolytic graphite can prevent contamination of the reactor coolant circuit by the highly radioactive fission products. Under a post-irradiation test program on the behaviour of various types of particle as a function of operating temperature, burnup, etc., a radiochemical study was made of the fission product distribution in the graphite surrounding the coated particles. For the analytic separation and assay of the fission elements distillation, precipitation, liquid-extraction, and ion-exchange techniques were used. The methods are briefly described. In this way 12 fission nuclides can be determined. A notably high mobility was observed for the fission elements Ba, Sr and Y. The release of other fission products with a higher fission yield is considerably lower. Some of the parameters affecting fission product release are discussed. Author

N67-27245# Argonne National Lab., Ill.
FARET IN-CORE INTRUMENT DEVELOPMENT
Glenn F. Popper and Alvin E. Knox Jul. 1966 75 p refs
(Contract W-31-109-ENG-38)
(ANL-7161) CFSTI: HC $3.00/MF $0.65

Development of instruments to measure fuel–pin and coolant temperatures, coolant flow in fuel assemblies, fission gas pressure buildup in fuel pins, and core neutron and gamma fluxes are described. Information is included concerning design of the FARET facility. NSA

N67-27320*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
AN ANALYSIS OF CRITICAL FUEL SOLUTION REACTORS CONTAINING ARRAYS ON VOID TUBES
Wendell Mayo Washington, NASA, 1967 14 p refs Presented at the 13th Ann. Meeting of the Am. Nuclear Soc., San Diego, 11–15 Jun. 1967
(NASA-TM-X-52302) CFSTI: HC $3.00/MF $0.65 CSCL 18K

A calculational method involving direct application of existing computer programs to extreme cases of heterogeneous voids is presented in an analysis of critical fuel solution reactors containing arrays of void tubes. An illustration is included for the geometry of the reactors which shows a 19 void tube configuration. The method consisted of obtaining the multigroup axial leakage rates out of the void tubes using transport theory solutions of an explicit cell containing a void tube and proportional part of the surrounding fuel solution. Next these axial leakage rates were incorporated into a gross cylindrical reactor calculation of the effective multiplication factor. A summary of the reactors studied and the calculated multiplication factors for both voided and unvoided reactors is presented in tabular form. One-dimensional radial calculations were used in the gross cylindrical reactor calculations, however the

method does not preclude two-dimensional calculations. Considering the wide range of reactors calculated the model appears to be reasonably accurate and amenable to direct application. S.P.

N67-27323# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
SCR: AN IBM-7094 CODE FOR THE CALCULATION OF NUCLEAR REACTOR FAST POWER TRANSIENTS [SCR: PROGRAMMA IBM-7094 PER IL CALCOLO DI TRANSISTORI RAPIDI DI POTENZA DI REATTORI NUCLEARI]
G. Casadei, C. Fucci, V. Leproni, G. Papa, and R. Scafe 1966 33 p refs In ITALIAN; ENGLISH summary
(RT-FIMA-(66)-4)

The SCR code may be used to calculate fast power transients, owing to accidents in water moderated reactors with plate-type fuel elements, not considering the reactor safety system. The kinetic equations solved are space-independent, with one energy group and N groups of delayed neutrons. The accidents are simulated by step and ramp (linear or parabolic) reactivity insertions. The reactivity feedback terms are dependent on metal and water temperature variations and void formation due to radiolytic gases and water boiling. The set of differential equations is solved by the use of numerical integration formulas of the Runge–Kutta type. Author (NSA)

N67-27324# Oak Ridge National Lab., Tenn.
EFFECTS OF CONTAINMENT SYSTEM SIZE ON FISSION PRODUCT BEHAVIOR
G. M. Watson, R. B. Perez, and M. H. Fontana Jan. 1967 47 p ref
(Contract W-7405-ENG-26)
(ORNL-4033) CFSTI: HC $3.00/MF $0.65

Some simple mathematical models were formulated for very rough predictions of the effect of containment size and other experimental variables on the plate-out behavior of iodine. Two classes of systems were considered depending on the absence or presence of steam and many simplifying assumptions were introduced. The mathematical expressions were correlated with experimental data from iodine–air and iodine–steam experiments in the Containment Mockup Facility, Containment Research Installation, and Nuclear Safety Pilot Plant with moderate success. NSA

N67-27325# Atomic Energy Commission, Washington, D. C. Office of Assistant General Manager for Reactors.
NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF DECEMBER 31, 1966
Jan. 1967 24 p
(TID-8200, 15th Rev.) CFSTI: HC $3.00/MF $0.65

Information is included on reactors categorized by their use. The categories are civilian, military, production, and export. Critical assembly facilities are also listed. NSA

N67-27327# Commissariat a l'Energie Atomique, Paris (France).
LONG-TERM VALUE OF PLUTONIUM [VALEUR DU PLUTONIUM A LONG TERME]
Sep. 1966 302 p refs In FRENCH; ENGLISH summary
(EUR-2967.f)

The main technical and economic data on the fabrication of Pu fuel elements, the production of this metal in reactors, and its extraction from irradiated fuels are reviewed. In order to formulate the problem of long-term value, a simulation model is constructed of an elementary mechanism of price formation between a producer and a consumer reactor. A further study of this general model would make it possible to consider the relations between several optimized reactor-groups. The complexity of this study would lie in the calculation of the Pu equilibrium prices. Finally, certain supplementary studies are mentioned which could be undertaken in order to better define the long-term value of Pu. Author (NSA)

N67-27328# Gesellschaft fur Kernenergieverwertung, Hamburg. (West Germany).
SHIELDING EXPERIMENTS AT THE REACTOR STATION GEESTHACHT [ABSCHIRMUNGSEXPERIMENTE AM FORSCHUNGSREAKTOR GEESTHACHT] Annual Report 1965
E. Bagge and E. Fischer 1966 220 p refs In GERMAN; ENGLISH summary
(EUR-2960.d)

The shielding experiments begun under the agreement between Euratom and Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt mbH (GKSS) were continued in 1965. The experimental facilities Estakos, Estagrop I, and the large irradiation channel in the FRG with the Estagrop II facility, were available for these studies. A research group developed and tested part of the measuring equipment and apparatus used in the experiments, and worked on the further development of neutron and gamma spectra measurement techniques. Work was continued on the calculation of the efficiency of shielding devices. Author (NSA)

N67-27334# Technische Hogeschool, Delft. (Netherlands).
ON THE DETERMINATION OF MICROSCOPIC REACTOR PARAMETERS USING AN EXPONENTIAL ASSEMBLY
Hans Robert Kleijn (Ph.D. Thesis) 1965 154 p
(NP-16426)

Results of analyses of exponential assemblies used in conjunction with reactors as neutron sources are presented. The practical uses of exponential assemblies are discussed and the Lead facility is described. A method of simulating boiling water is discussed and the determination of associated moderator void fractions is outlined. Reactor physics problems associated with the use of integral nuclear superheat reactors are examined. Measurements related to resonance escape probability and reactor thermal utilization factors are described. Results of measurements are compared with model calculation results. NSA

N67-27335# Oak Ridge National Lab., Tenn.
HFIR HOMOGENEITY SCANNER, PRODUCTION MODEL, OPERATING AND MAINTENANCE MANUAL
J. W. Reynolds, R. L. Shipp, T. F. Sliski, W. H. Longaker, and K. K. Klindt Feb. 1967 46 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1687) CFSTI: HC $3.00/MF $0.65

Fuel material in an HFIR fuel plate is U_3O_8 dispersed in aluminum, resembling an airfoil in cross section. To ensure uniform generation of heat within the plate, all plates must be tested (non-destructive) to determine that the U_3O_8 content is within specified limits. The HFIR Homogeneity Scanner was developed for this purpose. It is a density-thickness gauge that scans a plate with a highly collimated, 0.062-in.-diam beam of X-rays and detects those transmitted through the plate. Variations in the transmitted beam due to absorption in the fuel plate are used as a measure of fuel density. The operation of this machine and maintenance procedures for the electronic components are described. Author (NSA)

N67-27345# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
A STUDY ON THE RELEASE OF FISSION GASES FROM UO_2 SAMPLES IRRADIATED TO VARIED DOSES Quarterly Report, Jul.–Sep. 1966
Sep. 1966 19 p refs
(Contract EURATOM-043-65 TEEI(RD))
(EURAEC-1772; EUR-3319; QR-4) CFSTI: HC $3.00/MF $0.65

Experiments were made on the effects of radiation at various doses on UO_2 at 1400°C. Measurements were also made of the UO_2 surface area by the BET method. Detailed calculations were made of the burnup obtainable following irradiation of samples in the Sorin RS-1 swimming pool reactor. Data are tabulated. NSA

N67-27347# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

CAVITY REACTOR CRITICAL EXPERIMENT

J. F. Kunze, J. H. Lofthouse, G. D. Pincock, R. E. Wood, and R. E. Hyland 7 Oct. 1966 25 p refs Presented at 14th Conf. on Remote Systems and Technol., Pittsburgh

(Contract AT(40-1)-2847)

(GEMP-473; CONF-661001-41) CFSTI: HC $3.00/MF $0.65

The critical experiment reactor consists of a cylindrical reflector–moderator tank surrounding a concentric cavity containing a fueled volume of dilute uranium. The split table arrangement with two tanks which provides access to the cavity is shown. Critical masses, power distributions, reactivity worths of mockup heat shields, holes in the moderator tank, and the effects of varying fuel distribution are being studied. The reflector thickness and the cavity size are substantially greater than those in early experiments of this type, and the fuel has been dispersed throughout the specified volume of the cavity in the form of 0.0025-cm-thick Oralloy sheet material, to provide a realistic mockup of a gaseous core concept. Author (NSA)

N67-27349# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Physics.

TAMER: A COMPUTER PROGRAM USED IN STUDYING CORE THERMAL CONDITIONS DURING PLANT TRANSIENTS

J. W. Read 6 Sep. 1966 209 p refs

(Contract AT(04-3)-633)

(GAMD-7397) CFSTI: HC $3.00/MF $0.65

The computer code TAMER (Transient Analysis of Multiple Elements with Reverse Flow) was developed for studying nuclear reactor core thermal conditions during plant transients. The code is designed to compute the flow division among various ages of fuel regions and then calculate the temperature distribution for the coolant and fuel elements. The computations account for natural convection as well as forced convection conditions. Author (NSA)

N67-27350# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Physics.

PEACH BOTTOM, INITIAL LOADING TO CRITICALITY: RESULTS OF POST CONSTRUCTION R AND D TEST PROCEDURE BP-1

J. R. Brown and K. R. Van Howe 1 Oct. 1966 37 p

(Contract AT(04-3)-314)

(GAMD-7351) CFSTI: HC $3.00/MF $0.65

The loading of fuel into the Peach Bottom reactor began on February 5, 1966 with the placement of the first fuel element into the core. Loading was continued until a critical configuration was achieved with 682 fuel elements loaded on March 3, 1966. The predicted critical loading was 689 ± 20 elements. The approach to critical was monitored by performing inverse multiplication measurements at various stages during the loading sequence. The method of loading used was designed so that measurements during the subsequent low-power physics program would reflect as closely as possible the properties of the operating reactor. The location of detectors at the core-reflector interface with a source at the center of the core gave a very satisfactory approach to critical curve. The measured curve closely followed the predicted curve. The predicted and measured critical fuel element loading and critical mass were in close agreement. The reactivity of the just critical core agreed within 0.007 $\Delta\rho$ with the measured reactivity being greater. Since the calculations employed the most reactive thorium data, it appears that this data may be more appropriate than the Harwell 34 thorium data. The calculations neglected some possible negative reactivity effects such as neutron streaming and impurities. Inclusion of these effects could increase the discrepancy between the measured and calculated reactivity by as much as 0.010 $\Delta\rho$. It therefore appears that the U-235 data employed or some other effect may be producing too low a calculated reactivity. Author (NSA)

N67-27351# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Physics.

PULSED SOURCE MEASUREMENTS OF CONTROL ROD WORTH IN PEACH BOTTOM: RESULTS OF POST CONSTRUCTION R AND D TEST PROCEDURES BP-4, 6, 9, 13

J. R. Brown and K. R. Van Howe 1 Oct. 1966 48 p refs

(Contract AT(04-3)-314)

(GAMD-7352) CFSTI: HC $3.00/MF $0.65

An extensive series of pulsed neutron measurements was performed during the low power testing program of the Peach Bottom HTGR for the purpose of determining the reactivity worth of various control rod patterns and the degree to which the fully loaded core was subcritical with the 36 control rods inserted. Pulsed neutron measurements were performed in both a core with a minimum amount of excess reactivity (683 fuel elements) and the fully loaded core (804 fuel elements). The measurements in the 683 fuel element core yielded worths of control rods for configurations which will be encountered during power operation as well as a measurement of the reactivity worth of the entire bank of 36 control rods. This measurement, along with the measurement of the unrodded reactivity of the fully loaded core which was performed in the 683 element core, produced an early estimate of the shutdown margin to be expected in the fully loaded, fully rodded core. In general the pulsed neutron measurements in the Peach Bottom reactor yielded very close agreement between predicted and measured control rod worths. Approximately 25 different core configurations were pulsed, having reactivities as large as 40$ subcritical and 3 or more detector positions were used for each configuration. NSA

N67-27449# Los Alamos Scientific Lab., Mex.

A STUDY OF A NUCLEAR THERMIONIC PROPULSION SYSTEM

E. W. Salmi [1967] 4 p Presented at the Am. Inst. of Aeron. and Astronautics Meeting, New York

(Contract W-7405-ENG-36)

(LA-DC-8482; CONF-670111-1) CFSTI: HC $3.00/MF $0.65

A study was made of a nuclear electric space propulsion system. This study assumed that the system was composed of a thermionic reactor, "heat pipe" radiator and a Li arc jet propulsion unit. The specific weight of the entire system (unshielded) was 3.9 kg/kW jet power. Because of limited experimental evidence on fuel burn-up, the reactor operating time may be limited to 5000 hrs. This operating time is sufficient to accomplish the manned Mars mission. Author (NSA)

N67-27450# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik.

FAST BREEDER REACTORS, THEIR PRINCIPLES, THEIR DEVELOPMENT, AND THEIR ROLE IN A NUCLEAR ECONOMY [SCHNELLE BRUTREAKTOREN, IHR PRINZIP, IHRE ENTWICKLUNG UND IHRE ROLLE IN EINER KERN-ENERGIEWIRTSCHAFT]

Wolf Haefele Oct. 1966 32 p refs In GERMAN

(KFK-480)

The principles, development, and role of fast breeder reactors in a nuclear economy are outlined on the basis of a bibliographic study. The Karlsruhe fast breeder project is discussed in some detail. The studies made in Holland, Belgium, and the United States on fast breeder reactors are briefly indicated. NSA

N67-27488# Battelle Memorial Inst., Columbus, Ohio.

AN EVALUATION OF THE APPLICABILITY OF EXISTING DATA TO THE ANALYTICAL DESCRIPTION OF A NUCLEAR-REACTOR ACCIDENT Quarterly Progress Report, Oct.–Dec. 1966

David L. Morrison, Joseph M. Genco, James A. Gieseke, Robert L. Ritzman, Craig T. Walters et al. 1 Jan. 1967 57 p refs
(Contract W-7405-ENG-92)
(BMI-1790) CFSTI: HC$3.00/MF$0.65

The study is restricted to pressurized water and boiling water reactors. The maximum credible accident is considered to be loss-of-coolant or blowdown situation. Calculations are reported concerning accident heat transfer using Nurloc code. The program was used to compare thermodynamic calculations of Loft data by ANL, BMI, and Phillips Petroleum Company. Experimental measurements on UO_2 surface areas to define sphere radii for typical fuel were reviewed. Research was continued on fission product transport and deposition in reactor plenums, electric charging of aerosols, fission product transport and deposition in reactor containers, and effects of fission product removal systems. NSA

N67-27500# Puerto Rico Water Resources Authority, San Juan.
METALLURGICAL INVESTIGATIONS AND REPAIRS MADE ON BONUS STEAM DRYER–PREHEATER AND NONDESTRUCTIVE TESTS OF OTHER REACTOR COMPONENTS
Juan A. Bonnet, Jr., Carlos M. Bonet, and A. Gilberto Velez 31 Oct. 1966 91 p ref
(Contract AT(40-1)-2672)
(PRWRA-102) CFSTI: HC$3.00/MF$0.65

Methods devised for detection and repair of failures in stainless steel dryer–preheater piping and heaters of the Puerto Rico Power Reactor are described. NSA

N67-27551# European Atomic Energy Community, Brussels (Belgium). Directorate-General for Industry and Economy.
FIRST TARGET PROGRAMME FOR THE EUROPEAN ATOMIC ENERGY COMMUNITY
Paul de Groote Mar. 1966 362 p refs
(EUR-2773.e) CFSTI: HC$3.00/MF$0.65

The long term policy, aims, criteria, techniques, and future outlook for the First Target Program of the European Atomic Energy Community are presented. The status of the use of nuclear energy within the Community is discussed. Trends in supply and demand of electrical and nuclear energy; present industrial potential; and technical and economic prospects for proven type reactors, advanced converters, and fast reactors, are discussed. Also discussed are applications of the thorium cycle; supplies of uranium and thorium; and technical and economic prospects for the use of plutonium. Selected reactor development models are reviewed and compared. L.S.

N67-27583# Union Carbide Nuclear Co., Oak Ridge, Tenn.
GADOLINIUM OXIDE-30 WT % ALUMINUM OXIDE COMPACTS
Paul E. Trent 10 Mar. 1967 11 p refs
(Contract W-7405-ENG-26)
(Y-1571) CFSTI: HC$3.00/MF$0.65

Pellets made of 70 wt % Gd_2O_3–30 wt % Al_2O_3 were fabricated with densities >99% of theoretical. Three of these compacts were ground to specific dimensions and, using interferometer techniques, the thermal expansion coefficient of this material was determined for the temperature range of 25 to 900°C. Author (NSA)

N67-27590# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
THE HAMMER SYSTEM: HETEROGENEOUS ANALYSIS BY MULTIGROUP METHODS OF EXPONENTIALS AND REACTORS
John E. Suich and Henry C. Honeck Jan. 1967 72 p refs
(Contract AT(07-2)-1)
(DP-1064) CFSTI: HC$3.00/MF$0.65

The HAMMER system comprises programs for calculations of infinite lattice parameters by multigroup transport theory, and of composite reactor parameters by few-group diffusion theory. Operating procedures for this system of linked reactor physics codes are presented for the HAMMER system and for the auxiliary cross section library codes. Author (NSA)

N67-27595# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE PSEUDO TERNARY SYSTEM $BeO–UO_2–PuO_2$
C. E. McNeilly Jan. 1967 12 p refs
(Contract AT(45-1)-1830)
(BNWL-350) CFSTI: HC$3.00/MF$0.65

Phase relations in the $BeO–PuO_2–UO_2$ ternary system were determined by metallography, X-ray diffraction analysis, and melting point determinations on sintered pellets. BeO did not form a ternary compound or solid solution with $(Pu,U)O_2$. Under conditions of no O_2 loss, the lowest solidus in the ternary system was that of $BeO–PuO_2$ binary (2135°C). If O_2 loss could occur, the lowest solidus would be about 2000°C. NSA

N67-27596# Idaho Nuclear Corp., Idaho Falls.
ADVANCED TEST REACTOR BERYLLIUM SURVEILLANCE PROGRAM Status Report
J. M. Beeston and R. A. Moen Dec. 1966 54 p refs
(Contract AT(10-1)-1230)
(IN-1043) CFSTI: HC$3.00/MF$0.65

The status of the ATR Be Surveillance Program is presented along with pre-irradiation data and capsule designs. Sixty-four capsules containing Be samples were inserted into the ETR in April 1965 to build up irradiation exposure lead time on the ATR Be. These capsules will be transferred to the ATR upon startup of this reactor. Author (NSA)

N67-27600# Los Alamos Scientific Lab., N. Mex.
THEORETICAL AND EXPERIMENTAL TWO-DIMENSIONAL INTERACTIONS OF SHOCKS WITH DENSITY DISCONTINUITIES
Charles L. Mader, Roger W. Taylor, Douglas Venable, and James R. Travis 10 Feb. 1967 31 p refs
(Contract W-7405-ENG-36)
(LA-3614) CFSTI: HC$3.00/MF$0.65

The "PHERMEX" radiographic facility was used to study the interaction of shocks with cylindrical aluminum rods, "V" notches, and cylindrical voids in water. The experimental results are compared with two-dimensional numerical PIC (particle-in-cell) computations. Agreement between computation and experiment was within the resolution of the methods. Author (NSA)

N67-27615*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
QADHD POINT-KERNEL RADIATION SHIELDING COMPUTER CODE TO EVALUATE PROPELLANT HEATING AND DOSE TO CREW DURING ENGINE OPERATION
Gerald P. Lahti Washington, NASA, Jun. 1967 89 p refs
(NASA-TM-X-1397) CFSTI: $3.00 CSCL 18F

A Fortran IV computer program, QADHD, was written to evaluate the propellant heating in a nuclear rocket stage and to calculate the gamma and fast neutron doses received by a crew from the radiation emitted by the nuclear engine during the operating period. The LASL QAD4 is a general purpose program written to calculate gamma and fast neutron doses due to a volume-distributed source in a complex source-shield geometry that is generally describable by quadratic surfaces. QAD4 is a point-kernel code that employs infinite-medium buildup factors to calculate the gamma dose and employs the Albert–Welton kernel to calculate the fast neutron dose. QADH utilizes the QAD4 routines to evaluate local heating throughout the propellant (and tank wall) and then

integrates these heating rates over the entire volume of the propellant. Assuming that this heat is distributed uniformly throughout the propellant by natural convection (the complex-mix model) permits the rate of temperature rise of the propellant to be determined. QADH then determines the total temperature rise and accumulative heat input to the propellant as a function of reactor operating time. In some nuclear rocket configurations, the propellant may serve to shield the crew from radiations emitted by the engine. In these cases QADD utilizes the QAD4 routines to calculate biological dose rates to the crew during engine operation while the propellant depth in the tank (or amount of shielding the propellant provides) changes with time. QADD then integrates these dose rates over engine operating time to obtain a total dose-time history. Author

N67-27636# Institutt for Atomenergi, Kjeller (Norway).
IRRADIATION EXPERIENCE WITH THE FIRST UO_2 ALUMINIUM CLAD FUEL TESTED IN HBWR
K. Videm, S. Aas, A. Hanevik, and E. Jensen Sep. 1966 25 p refs
(KR-112)

This report describes the reactor experience with the first aluminium clad fuel element tested under HBWR conditions, (230°C, 28 kg/cm^2). The cladding alloy used had the following composition: 1% Ni, 11% Si, 0.5% Fe, 0.8% Mg, 0.1% Ti, Bal.Al. After a total irradiation time of 140 days, corresponding to an integrated power of 730 MWD/t at two channel power levels, one of the stringers failed at two bulb-shaped distortions, one at either end of the stringer. The primary reason for the failure was corrosion of accidental inclusions of pure aluminium in the aluminium alloy cladding. The bulb-shaped distortions were caused by reaction between the thermal isolation pellets of magnesia and in-leaked water. The general behavior of the other stringers was satisfactory. Based on the experience with these elements two new assemblies have been made and are being irradiated. Author

N67-27637# Institutt for Atomenergi, Kjeller (Norway).
INTRACELL NEUTRON DENSITY DISTRIBUTIONS IN H_2O, D_2O AND H_2O/D_2O MODERATED LATTICES
R. J. J. Stamm'ler Oct. 1966 33 p refs Presented at the EAES Symp. on "Advances in Reactor Theory", Karlsruhe, W. Germany, 27–29 Jun. 1966 Sponsored in part by Reactor Centrum Ned.
(KR-113)

Intracell neutron density distributions and disadvantage factors have been calculated using the computer program K-7 THERMOS. The influence of the transport correction and the use of different energy transfer models on the density distribution as well as on the spectrum's spatial variation expressed in terms of a suitably defined spectrum index is investigated. Two approximate methods for finding flux disadvantage factors are described and compared with K-7 THERMOS. The results are also compared with those of detailed measurements in metal and oxide fueled cores and in most of the cases satisfactory agreement is observed. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N67-28555*# Utah Research and Development Co., Inc., Salt Lake City.
CRATERING IN LOW-DENSITY TARGETS
Emerson T. Cannon and Gerry H. Turner Washington, NASA, Jun. 1967 19 p ref
(Contract NASw-1196)
(NASA-CR-798) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Craters were formed with aluminum, steel, nylon, and magnesium projectiles in targets made of rigid and flexible polyurethane foams, foamed glass, and natural pumice. The velocity range involved was 4.7 to 6.9 km/sec. Crater dimensions and volumes were determined. Values of shear strength and shearing energy were determined for all target materials. Some comparison was done among different projectile–target combinations to better understand the reasons for differences in crater shape. Values were determined for target mass displaced in a crater per unit of energy involved. It was found that projectiles of some materials are much more efficient in cratering than are others; steel projectiles being less efficient than the other types used by as much as a factor of one-half. Author

N67-26611# Illinois Univ., Urbana. Coll. of Engineering.
PHYSICS
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 157–181 refs
(See N67-26601 14-34)

Theoretical and experimental research is summarized within the subfields of solid state and low temperature physics, and nuclear elementary particle physics. Specific topics presented are: cyclotron research, fissile element cross sections below 100 eV; microwave investigations of plasmas and computer-controlled reactor fuel. R.U.

N67-26621*# National Aeronautics and Space Administration, Washington, D. C.
GENERAL THEORY OF ASYMMETRIC WAVES IN A CIRCULAR WAVEGUIDE WITH AN OPEN END [OBSHCHAYA TEORIYA NESIMMETRICHNYKH VOLN V KRUGLOM VOLNOVODE S OTKRYTYM KONTSOM]
L. A. Vaynshteyn May 1967 24 p refs Transl. into ENGLISH from Zh. Teckhn. Fiz. (Leningrad), v. 21, no. 3, 1951 p 328–345
(NASA-TT-F-473) CFSTI: HC $3.00/MF $0.65 CSCL 20B

A rigorous solution is obtained for the problem in which an asymmetric electric or magnetic wave propagates inside a circular waveguide towards its open end (semi-infinite tube). Since the electromagnetic field produced by the diffraction of this wave at the end of the tube has two Hertz functions, the solution is considerably more complicated than for the symmetric waves. Equations are presented for the reflection coefficient of the incident wave from the open end, and also equations for the transformation coefficients of this wave into other waves (including the transformation coefficients of electric waves into magnetic waves and vice versa). The radiation field is investigated and design equations are presented for the radiation characteristics. Approximate equations are derived for the radiation field and for the reflection and transformation coefficients. Author

N67-26740# Case Inst. of Tech., Cleveland, Ohio.
ANALYSIS OF ELECTROMAGNETIC RADIATION IN THE PRESENCE OF UNIFORMLY MOVING GENERALIZED MEDIA Scientific Report
Ioannis M. Besieris Bedford, Mass., AFCRL, Nov. 1966 163 p refs
(Contract AF 19(628)-1699)
(AFCRL-66-827; SR-15; AD-648985) CFSTI: HC $3.00/MF $0.65

The analysis of electromagnetic radiation arising from elementary sources in the presence of a class of generalized media is presented. The electromagnetic field intensities associated with an isotropic, conducting, moving medium are expressible in terms of a pair of scalar and vector potential functions by invoking a generalized Helmholtz theorem and a modified Lorentz condition.

The time-dependent scalar Green's function defined in connection with the partial differential equations satisfied by these potential functions is determined explicitly by resorting to an expansion of a function of a diagonalizable matrix. The radiation due to a magnetic dipole oriented along the distinguished axis of a stationary, conducting, uniaxially-anisotropic medium is found by writing separate equations for the electromagnetic field intensities, and utilizing a spectral representation in the space-time Fourier domain. The electric conductivity and permittivity tensors are assumed to be proportional to each other. The change in the character of radiation in the presence of a uniaxially-anisotropic medium moving uniformly in the direction of its axis of symmetry is investigated next. Because of the existing symmetry, it is possible to obtain explicit analytic solutions for a longitudinally- and a transversely-oriented unit magnetic current distribution density. Finally, the exact radiation field in a general anisotropic, conducting, moving medium is presented formally as an integral representation in terms of the generalized spectrum of a nonsemisimple matrix. Author (TAB)

N67-28911# RAND Corp., Santa Monica, Calif.
THE EQUIVALENCE OF THE ISOTROPIC AND MONODIRECTIONAL SOURCE PROBLEMS
H. H. Kagiwada and R. E. Kalaba Mar. 1967 13 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5295-PR; AD-648506) CFSTI: HC $3.00/MF $0.65

A demonstration that the solution of the problem of multiple scattering in a slab that is illuminated by parallel rays of radiation can be expressed in terms of the solution of the problem in which there are isotropic sources of radiation. The quantities of interest for the monodirectional case (the X, Y, I, S, J, and T functions) are given algebraically in terms of the b and h functions that express the internal intensities for the isotropic source problem. For I, this avoids a matrix inversion, thus overcoming a difficulty associated with the direct application of Chandrasekhar's invariance principles. This study is an extension of RM-4906-PR (AD-630 121). Author (TAB)

N67-28953# California Univ., La Jolla. Visibility Lab.
UNDERWATER OPTICS
S. Q. Duntley 10 Dec. 1966 20 p
(Contract Nonr-2216(14))
(AD-647791) CFSTI: HC $3.00/MF $0.65

The irradiance pattern was measured for the propagation of a collimated beam of light underwater. A neodymium-doubled green laser was transmitted horizontally at a six foot depth in Lake Winnipesaukee, N. H. The irradiance was measured at distances from 0 to 100 feet and for off-axis angles from 0 to 58 degrees. The water had an attenuation length of 4.54 ft/in and an absorption coefficient of 0.0446 in/ft. The ratio of attenuation coefficient to absorption coefficient was 4.94. The fractional power contained within a cone of various angles was computed. At 20 attenuation lengths only 10% of the total power is contained within a cone of 4 degrees whereas at 4 attenuation lengths this same cone contains 50% of the power. Author (TAB)

N67-28954# Minnesota Univ., Minneapolis.
RESEARCH ON TRANSPORT AND TRANSFORMATION IN CONTINUA Final Scientific Report, 16 Feb. 1963–15 Oct. 1966
L. E. Scriven Dec. 1966 12 p refs
(Grant AF-AFOSR-219-63(A))
(AFOSR-67-0401; AD-648962) CFSTI: HC $3.00/MF $0.65

A summary report is given of research performed over a three year period in the interrelated areas of continuum physics: (1) theory of energy transport and transformation in continuous systems, with emphasis on active-stress mechanisms of chemical to mechanical energy transformation in anisotropic materials (2) field theory as it applied to densities, transport fluxes, transformation rates, and especially the occurrence and symmetry properties of dynamic structure and (3) theory of structured continua, with emphasis on studies of simple precursors of continuous systems and on use of polarization variables to represent internal configuration in constitutive equations. Author (TAB)

N67-28961# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUPERCONDUCTING ELECTROMAGNET OF Nb_3Sn
Wei-yen Kuan, Ti-han Liu, and Guo-kuang Cheng 5 Dec. 1966 22 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 21, no. 7, 1965 p 1345–1354
(FTD-HT-66-509; TT-67-61325; AD-648885) CFSTI: HC $3.00/MF $0.65

Results of study on tubular Nb3Sn magnets are presented. Magnetic flux jumping was observed. The frozen field distribution is closely related to the external field distribution and previous history. The distribution need not be symmetrical with respect to the mid-plane perpendicular to the cylindrical axis, as in the case of soft superconductors. This confirms the suggestion that the sintered Nb3Sn material is not a homogeneous medium. A new magnet structure is described with which magnetic flux jumping can be avoided. With these magnets, besides the use of the iron core for trapping magnetic flux, there are also special features in both the excitation and the measurement of magnetic fields. An extremely high magnetic field of 28.5 KG at 1.5K is obtained by the use of the tubular Nb3Sn as a piston. Author (TAB)

N67-28963# General Dynamics/Convair, San Diego, Calif.
A FORTRAN IV PROGRAM TO DERIVE THE EQUATIONS OF MOTION OF SYSTEMS
Robert A. Westerwick and J. B. Brown Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Sep. 1966 130 p refs
(Contract AF 33(615)-1836)
(AFFDL-TR-65-194; AD-648720) CFSTI: HC $3.00/MF $0.65

The state of the art of computer development has reached the point where it is now possible to sacrifice some of the extremely high speed of arithmetic computations in order to relieve man of tedium in another area - that of algebraic computation. The report presents the results of a development which uses an IBM 7090/94 computer to derive in nonnumeric terms the equations of motion of a system. This system can be composed of any number of masses which are acted upon by forces due to springs, dampers, gravity, and external forces. Author (TAB)

N67-27010# Stanford Univ., Calif. Dept. of Materials Science.
THE GENERATION OF SCIENCE-BASED TECHNOLOGY IN THE FIELD OF CRYSTALLIZATION
W. A. Tiller Jan. 1967 48 p refs
(Grant AF-AFOSR-731-65)
(SU-DMS-67-1; Rept.-21; AD-648218) CFSTI: HC $3.00/MF $0.65

The paper is concerned with the reorientation of the field of crystallization to a science-based, as opposed to an art-based, technology. A summary of the fields of science and the general knowledge which are necessary to engineer a crystallization application is followed by a discussion of the Crystallogenics approach and its successes. Finally, consideration is given to present exploitation opportunities in the areas of materials purification and concentration; single crystal growth, with particular attention given to the growth of silicon webs, large selenium single crystals, and large sapphire single crystals; and structure control of ingots and castings. TAB

N67-27019# Texas Instruments, Inc., Dallas.
TITANIUM CHALCOGENIDE INFRARED TRANSMITTING GLASSES Final Technical Summary Report, 1 Feb. 1966–31 Jan. 1967

A. Ray Hilton Feb. 1967 37 p refs
(Contract N00014-66-C0085; ARPA Order 269)
(TI-08-67-18; AD-648076) CFSTI: HC $3.00/MF $0.65

Two experimental approaches were used in attempts to compound non-oxide chalcogenide glasses based on the transition element titanium. The first was an open-chamber method in which the reactants were rapidly heated using a high-temperature dc arc. Heavy losses of volatile constituents during the arcing process prevented this method from producing a homogeneous melt. In the second method the reactants were sealed in a quartz vial which was supported by either a boron nitride or a graphite chamber. Compounding the Ti-V-Te system at 1600 to 1700C produced a homogeneous melt, but glasses did not form when the melt was quenched. Selenium glasses containing the transition elements nickel, zinc, and manganese were formed but none had physical properties significantly better than selenium glasses evaluated previously. No tellurium-based glasses containing transition elements formed. Author (TAB)

N67-27081*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
RESEARCH LABORATORY OF ELECTRONICS Quarterly Progress Report, Period Ending 28 Feb. 1967
15 Apr. 1967 369 p refs
(Contract NSR-22-009-120; Grants NsG-496, NsG-334, NsG-419; NGR-22-009-163 et al)
(NASA-CR-84300; QPR-85) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Articles summarizing quarterly research in general physics, plasma dynamics, and communication sciences and engineering are presented. For individual titles see N67-27082–N67-27105.

N67-27091*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PHYSICAL OPTICS OF INVERTEBRATE EYES
In its Res. Lab. of Electron. 15 Apr. 1967 p 69–70 (See N67-27081 14-23)
(Contract DA-28-043-AMC-02536(E))

The physical optics of the compound eye of the Tobacco Hornworm Moth is considered. A 350X magnified photograph shows the thin ($\approx 2\ \mu$), unstained normal section of the moth's eye observed by using Zernike phase contrast. It is noted that the cone and the cornea appear structured when observed by phase contrast in the light microscope, thereby suggesting a varying index of refraction (n) with position. Experimental results confirm the fact that the focal length examined is different. R.Ll.

N67-27354# Joint Publications Research Service, Washington, D. C.
ACOUSTICS OF THE OCEAN
T. Ye. Mikhal'tsev 20 Mar. 1967 33 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Fiz. Atm. i Okeana (Moscow), v. 3, no. 1, 1967 p 78–100
(JPRS-40314; TT-67-30959) CFSTI: HC $3.00

The general state and basic problems involved in acoustics of the ocean as a division of physics of the ocean is discussed. Six research areas have been delineated: transmission of an acoustic signal, signal fluctuations, scattering of sound, absorption of sound energy, noises and sounds in the ocean, and acoustic methods of marine research. The major factors conditioning the influence of general oceanologic characteristics on the mechanisms of acoustic field change in the ocean are indicated. Promising acoustic methods of conducting marine studies for the four primary divisions of oceanology are described. Author

N67-27374*# Florida Univ., Gainesville.
A STUDY OF DEFECT STRUCTURES WITH THE FIELD ION MICROSCOPE Semiannual Report, Sep. 1, 1966–Feb. 28, 1967
J. J. Hren, R. W. Newman, and R. C. Sanwald 28 Feb. 1967 12 p refs
(Grant NGR-10-005-039)
(NASA-CR-84415; SAR-2) CFSTI: HC $3.00/MF $0.65 CSCL 20F

The research effort in field ion microscopy to date is briefly reviewed. Significant advances include: (a) development of considerably improved image resolution through the use of fiber optics, (b) an improved method for indexing field ion micrographs, (c) accurate computer simulation of the image using new criteria, (d) computer simulation of the "appearance" of a screw dislocation intersecting several crystallographic planes on a field ion tip, (e) computer simulation of a variety of dislocation images in FCC crystals, and (f) an analysis of short- and long-range order in Ni–Mo alloys. Author

N67-27457# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
DIFFUSION OF RARE GASES IN SOLIDS Final Report
F. Felix, comp. Feb. 1966 42 p
(Contract EURATOM-028-64-1 TEE)
(EURAEC-1650; EUR-2848; EU-B-42; FR-4) CFSTI: HC $3.00/MF $0.65

The results of post-activation diffusion (PAD) measurements of rare gases in the solids UO_2, UC, and ThO_2, UO_2, CaF_2, CaO, KF, KCl, KBr, and KI and tritium in AgLi are reported. Remarks concerning the detailed individual representations of the systems and a survey of the measuring methods used are followed by a comparison of the temperature dependence of the rare gas release on the basis of the volume diffusion of these systems. The deviations observed from the ideal diffusion kinetics owing to vaporization of the sample and the effect of rare gas traps are discussed in detail in connection with experimental examples. A list of references concerning diffusion measurements on UO_2 and UC is appended. Author (NSA)

N67-27481# Brookhaven National Lab., Upton, N. Y.
DESIGN STUDY OF A SUPERCONDUCTING RADIOFREQUENCY BEAM SEPARATOR
H. Hahn and H. J. Halama 28 Feb. 1967 7 p refs Presented at Natl. Particle Accelerator Conf., Washington, D. C.
(Contract AT(30-2)-GEN-16)
(BNL-11048; CONF-670307-2) CFSTI: HC $3.00/MF $0.65

A design study of a superconducting RF beam separator suitable for counter beams is presented. A simple two-deflector separation scheme permits one-contaminant rejection in momentum ranges from 8.5 to 19 GeV/c for p and π beams and from 4.5 to 10 GeV/c for K beams. The operating wavelength $\lambda = 24$ cm was obtained by optimizing the transmission of wanted particles. An interdeflector spacing of L = 33 m follows. The geometrical configuration of the lead-coated iris-loaded structure is selected for highest bandwidth which is obtained when the ratio of aperture radius and wavelength is close to 0.2. The maximum deflecting field in the 3 m long resonant ring deflector is limited to about 7 MV/m. The superconducting structure is expected to have a shunt impedance of $R \approx 10^{12}\ \Omega/m$ and an unloaded quality factor of $Q_0 \approx 1.5 \times 10^9$. The ensuing RF power requirements are discussed. Author (NSA)

N67-27544*# Avco-Everett Research Lab., Everett, Mass.
ADVANCED SUPERCONDUCTING MAGNETS INVESTIGATION Quarterly Progress Report, 10 Nov. 1966–10 Feb. 1967
Mar. 1967 35 p refs
(Contract NAS8-21037)
(NASA-CR-84456; QPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 20C

Theoretical models were used to study the thermal and electrical behavior of composite conductors. The zero- and one-dimensional theories are fairly complete; but the study of three-dimensional

effects is still under development. A test facility is under construction for use in providing experimental evidence to confirm predicted behavior. L.S.

N67-27545# Royal Military Coll. of Science, Shrivenham (England).
A THEORETICAL INVESTIGATION OF DIELECTRIC AERIALS. PART I: RADIATION FROM THE T.M. MODE IN A CIRCULAR ROD
J. R. James Dec. 1965 37 p refs
(RT-27)

The literature is reviewed and shown to be in contradiction, regarding the precise nature of radiation from dielectric aerials. A major contribution, which proves that a dielectric rod acts as a leaky waveguide, is shown to be fallacious owing to the incorrect use of Schelkunoff's Equivalence Principle. It is shown that the correct use of this principle predicts experimental patterns very accurately (for the T.M. mode) and establishes that dielectric rod aerials are not leaky guides but radiate through the aperture at each end of the rod. Dielectric tube aerials and other surface wave aerials are briefly discussed and precise methods of analysis outlined. Author

N67-27548# Royal Military Coll. of Science, Shrivenham (England). Electronics Branch.
A THEORETICAL INVESTIGATION OF DIELECTRIC AERIALS, PART III: THE ANALYSIS OF TYPICAL DIELECTRIC ROD AERIALS EXCITED IN THE He_{11} MODE
J. R. James Jul. 1966 47 p refs
(RT-31)

By applying the vector Kirchoff Formula, an expression is derived for the (E and H plane) far field radiation pattern of a typical uniform dielectric rod aerial. Certain assumptions are made in the analysis and provided these are observed, the agreement between theory and experiment is very good. The extension of this theory to tapered dielectric rod aerials is considered and shown to be possible for gradual tapers. The analysis provides a means of assessing the power radiated at the metal waveguide aperture and also permits losses in the dielectric rod to be allowed for. Recommendations for a well designed dielectric rod aerial are put forward and it is considered that the optimization of the launching of the surface wave on to the rod, is likely to lead to much improved performances. Other dielectric radiators are discussed in the light of these findings. Author

N67-27569*# International Information, Inc., Philadelphia, Pa.
ON THE OPTIMAL STABILIZATION OF THE ROTATING MOTION OF A SOLID WITH A FIXED POINT BY MEANS OF FLYWHEELS [OB OPTIMAL'NOY STABILIZATSII VRASHCHATEL'NOGO DVIZHENIYA TVERDOGO TELA S NEPODVIZHNOY TOCHKOY PRI POMOSHCHI MAKHOVIKOV]
U. V. Krementulo Washington, NASA, Mar. 1967 13 p refs Transl. into ENGLISH from Inzh. Zh. (Moscow), no. 6, 1966 p 11–18
(Contract NASw-1499)
(NASA-TT-F-10739) CFSTI: HC$3.00/MF$0.65 CSCL 20K

The author extends earlier results to the case of the rotation motion of a solid. The system investigated consists of a solid with a fixed point in the center of gravity. Axes of three homogeneous, symmetrical, engine-rotated flywheels lie along the principal central axes of inertia of the fixed point. Author

N67-27632# Royal Military Coll. of Science, Shrivenham (England).
A THEORETICAL INVESTIGATION OF DIELECTRIC AERIALS. PART II: THE DEPENDENCE OF EXISTING RADIATION THEORIES ON THE VECTOR POTENTIAL WAVE EQUATION
J. R. James Apr. 1966 32 p refs
(RT-30)

This note examines the suitability of the vector Kirchhoff Formula for solving the entire radiation field of a dielectric aerial. It is shown that present day radiation theories are all based on the vector Kirchhoff Formula and it is proved that this is identical to Schelkunoff's Equivalence Principle. It is revealed that these theorems require the vector potential wave equation to be inhomogeneous, although this is not made clear in their proofs. The inference then follows that these theories cannot be applied, without due care, to problems involving both surface waves and radiating waves. A dielectric aerial is shown to be such a case, and two examples are quoted where the dependence on the vector potential has been ignored. The approximations that are valid in the Fraunhofer, Fresnel and near zone regions, are briefly discussed with specific reference to dielectric aerials. Author

N67-27681# Southampton Univ. (England). Inst. of Sound and Vibration Research.
AN INTRODUCTION TO SOUND RADIATION AND ITS SOURCES
P. E. Doak Sep. 1966 38 p refs
(ISAV-MEMO-154)

An introductory chapter on the dynamics of sound waves is presented. Mathematical discussions are given on two- and three-dimensional sound waves, their propagation, and their associated energy densities. The acoustic field of sound radiators is considered with respect to uniformly pulsating spheres and oscillating spheres. The concept of radiation impedance and the principle of reciprocity are reviewed, and their use for rough estimates of acoustic radiation and scattering is indicated. Multipole analysis is applied to acoustic radiation when the disturbance amplitude is finite, and transverse shear waves and thermal disturbances may also propagate through the material. N.E.N.

N67-27739# Lockheed Missiles and Space Co., Palo Alto, Calif.
FINITE ROTATIONS OF A BODY UNDER THE EFFECT OF ROTATION OF INTERNAL FLYWHEELS
V. G. Aver'ianova [1967] 7 p refs Transl. into ENGLISH from Inzh. Zh., Mekhanika Tverdogo Tela, no. 1, 1967 p 15–19

The finite rotation of a solid caused by the rotation of a coupled flywheel was investigated by B. A. Smol'nikov. The problem was solved of seeking the flywheel axis and its angle of rotation which would assure a given finite rotation of the solid. A rather different problem is solved in this paper: given a solid with two coupled flywheels with invariant axes, determine what rotation to communicate to these flywheels so that the body would perform any given finite rotation, i.e., so that it could turn from an arbitrarily given initial to an arbitrarily given final position. It is assumed that the total kinetic moment of the system is zero. The solution is based on a geometric interpretation of the addition and decomposition of finite rotations of a solid. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N67-26512* Wisconsin Univ., Madison. Theoretical Chemistry Inst.
SEMI-EMPIRICAL POTENTIAL ENERGY CURVES FROM SIMPLE APPROXIMATE WAVE FUNCTIONS
Morton A. Elisson and Joseph O. Hirschfelder 20 Dec. 1966 57 p refs
(Grant NsG-275-62)
(NASA-CR-84152; WIS-TCI-206) CSCL 20H

Semi-empirical potential energy curves for the interaction of two hydrogen atoms in the $^1\Sigma_g^+$ and $^3\Sigma_u^+$ states have been calculated by assuming a simple approximate wave function, computing the expectation value of the Hamiltonian for the system, and than considering the units of energy, e^2/a_o, length, a_o, and the screening parameter to be adjustable parameters, to be chosen to give as good a fit of the true curve as possible. The trial functions used were made up from ls hydrogenic or Gaussian atomic orbitals; some allowance for polarization was included in a number of the computations. The resulting curves fail to give as faithful a representation of the true curves as had been desired. Further improvement would require the addition of undesirable complexity in the trial functions and therefore in the computations for this and for more complex systems. Author

N67-26549*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PROTON BOMBARDMENT OF HIGH-PURITY SINGLE-CRYSTAL SILICON

J. R. Robertson, R. F. Franks, and T. E. Gilmer, Jr. (Ph.D. Thesis—Virginia Polytech. Inst.) Washington, NASA, May 1967 26 p refs

(NASA-TN-D-3989) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Bombardment of high-purity silicon with 22-MeV protons has produced Al^{27} at a rate of 6×10^{-3} atom per proton in a thick target. The aluminum was identified by the Al_s infrared absorption spectrum. The production of aluminum in the crystals eliminated the study of damage in impurity-free silicon but, in return, provided for a study of defect interactions with aluminum. The production rate of aluminum is high enough that anyone studying radiation damage by protons should be aware of the presence of the aluminum. Three new infrared absorption bands were observed in the irradiated silicon with main peaks at 8.9, 14.2, and 21.0 microns. Production of the 21.0-micron band required high sample temperature during bombardment and is identified as (substitutional aluminum)+(vacancy cluster). The 8.9- and 14.2-micron peaks appear and disappear with successive annealing. The possibility is mentioned that one or both of these lines might be due to $(Al^{++}_{substitutional} + Al^{++}_{interstitial})^+$. The 20.5-micron absorption band, which has been reported in neutron irradiated silicon, was found in proton irradiated silicon. Author

N67-26554*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

GENERALIZED POTENTIALS FOR INELASTIC SCATTERING

Howard C. Volkin Washington, NASA, May 1967 53 p refs

(NASA-TN-D-4000) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The generalized potential that gives the scattering into a selected group of inelastic channels along with the elastic scattering is derived by means of the projection operator for the set of channels. A general class of projection operators that selects all open channels is developed in terms of the previous projection operator. The resonance part of the generalized potential can then be obtained by means of Feshbach's unified theory of nuclear reactions. There is no limitation on the types of reactions that can occur. Examples of projectors belonging to the class are given for the case of two-channel reactions. An example which is discussed in some detail is the pickup process. After the resonance contributions have been isolated, the transition amplitudes can be energy averaged. The result is used to obtain the generalized optical potential. The properties of the potentials that follow from the equations which determine them are discussed. A short review is given of some elements of Feshbach's reaction theory that are required. Author

N67-26566*# National Aeronautics and Space Administration, Washington, D. C.

THEORY OF ELEMENTARY PARTICLE SYMMETRY [K TEORII SIMMETRII ELEMENTARNYKH CHASTITS]

Yu. V. Novozhilov and I. A. Terent'yev Feb. 1967 16 p refs Transl. into ENGLISH from Vestn. Leningrad. Univ., Ser. Fiz. i Khim. (Leningrad), v. 21, no. 16, 1966 p 5–17

(NASA-TT-F-10618) CFSTI: $3.00 CSCL 20H

A problem is solved which is equivalent to the solution of Dirac-like wave equation for free particles in ISL(2m, c) and IU(m, m) symmetries. The properties of basic matrices Λ_A, A=0, 1, ..., n^2-1, n=2m are summarized. The group relations are considered with special emphasis on the properties of n^2-dimensional momenta space of ISL(n, c). The chain of groups ISL(2m, c) IU(m, m) ISL(m, c) is studied, each subsequent group being the subgroup of the preceding one (ISL(M, c) denotes the ISL(m, c)-group with reflection). The Wigner operator $\alpha(p)$ is constructed which gives a generalized momentum P for the rest frame. The system of independent normals in n^2-dimensional vector space of ISL(n, c) is introduced so that the problem of finding $\alpha(p)$ is reduced to the one of $d_{1/2}=Sp(P)^{1/2}$, where $P=p_A\Lambda_A$ is the momentum matrix. The quantity $d_{1/2}$ can be calculated explicitly for $n\leq4$ in the case of ISL(n, c) and $m\leq4$ for IU(m, m). An integral representation for d_s, $0<s<1$ is given for the general case. Author

N67-26598*# National Aeronautics and Space Administration, Washington, D. C.

ON THE THEORY OF COULOMB INTERACTION [K TEORII KULONOVSKOGO VZAIMODEYSTVIYA]

I. I. Tugov May 1967 21 p refs Transl. into ENGLISH from Joint Inst. for Nucl. Res. Rept. No. JINR-P-2638

(NASA-TT-F-474) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A differential equation in the momentum space has been obtained for a many-dimensional Coulomb problem. An equivalence is shown of this equation to the wave equation in a space of constant curvature K>0 for a discrete spectrum E<0 and K<0 for scattering in a field of attraction and in a field of repulsion. Solving Killing's equations gives generators of the symmetry group of the equation. Possible sets of quantum numbers are investigated. An explicit form of diagonal operators is presented and normalized systems of eigenfunctions of the discrete and continuous spectra have been constructed for a number of coordinate systems in the three-dimensional case. When scattering in a field of attraction and in a repulsion field, the wave functions are infinite equivalent representations of the Lorentz groups belonging to the principal series of unitary representations. Author

N67-26616*# Columbia Univ., New York. Columbia Radiation Lab.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM Progress Report, 1 May–31 Oct. 1966

R. Novick 31 Oct. 1966 116 p refs

(Grants NsG-360; NsG-442; NsG-445; Contracts DA-31-124-ARO(D)-305; DA-31-124-ARO(D)-341 et al)

(NASA-CR-84299; PR-14; CU-10-66-PMC-00099(E)-Phys; AD-646898) CFSTI: HC $3.00/MF $0.65 CSCL 20H

CONTENTS:

1. ATOMIC PHYSICS p 3–49 refs (See N67-26617 14-24)

2. PHYSICS OF MOLECULES p 50–75 refs (See N67-26618 14-24)

3. SOLID STATE PHYSICS p 76–92 refs (See N67-26619 14-26)

4. RADIO AND X-RAY ASTRONOMY p 93–102 refs (See N67-26620 14-30)

N67-26617*# Columbia Univ., New York. Columbia Radiation Lab.

ATOMIC PHYSICS

In its Res. Invest. Directed Toward Extending the Useful Range of the Electromagnetic Spectrum 31 Oct. 1966 p 3–49 refs (See N67-26616 14-24)

Atomic physics research is reported in the areas of metastable atoms and ions, level-crossing and optical double-resonance spectroscopy, and collision phenomena. Factual data, conclusions, and programs for the contract period are briefly outlined. R.Ll.

N67-26618*# Columbia Univ., New York. Columbia Radiation Lab.

PHYSICS OF MOLECULES

In its Res. Invest. Directed Toward Extending the Useful Range of the Electromagnetic Spectrum 31 Oct. 1966 p 50–75 refs (See N67-26616 14-24)

(Contracts N00014-67-A-0108-0002; DA-31-124-ARO(D)-296; Grant AF-AFOSR-330-66)

Molecular physics research efforts are reported under the following subheadings: beam maser spectroscopy, electron excitation of molecular hydrogen, scattering of velocity selected molecular beams, magnetic rotation spectra, molecular spectra of cesium, laser studies of molecular birefringence and optical activity, and optical laser spectroscopy of fluids. R.Ll.

N67-26661# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.

ELECTROMAGNETIC PULSE PROPAGATION IN A DISTURBED TERRESTRIAL WAVEGUIDE

J. Ralph Johler Dec. 1966 77 p refs

(IER-22-ITSA-22; AD-648002) CFSTI: HC$3.00/MF$0.65

Previous papers which treat pulse propagation (with special reference to the nuclear pulse) assume the ionosphere to be normal. Thus, a theoretical model of the ionosphere has been employed which represents undisturbed conditions. This paper extends this propagation analysis to a disturbed condition resulting from the ionizing radiation of nuclear debris spread over a large area. The effect of the debris on the transforms for the propagation medium together with the detailed dispersion of a particular pulse are considered. The lowering of the ionosphere reflection height at low frequencies causes shorter propagation times for the pulses reflected from the ionosphere. The effect causes considerable change in the form or shape of the observed composite pulse at great distance from the source. Author (TAB)

N67-26667# Illinois Univ., Urbana. Dept. of Physics.

PARTICLE NUCLEUS INTERACTIONS AND THE REGGE MODEL

P. B. James, R. K. Logan, and H. D. D. Watson [1967] 13 p refs

(Grant NSF GP 6198)

(AD-648017) CFSTI: HC$3.00/MF$0.65

It is proposed that the Regge pole model may be applied to the high energy scattering of particles (pion, K,N) by nuclei. The deuteron total cross sections are shown to be consistent with this hypothesis. Author (TAB)

N67-26675# Michigan Univ., Ann Arbor. Physics Dept.

FIVE-DIMENSIONAL QUASISPIN. THE n, T-DEPENDENCE OF SHELL MODEL MATRIX ELEMENTS IN THE SENIORITY SCHEME

K. T. Hecht Feb. 1967 97 p refs

(Contract Nonr-1224(59))

(AD-648531) CFSTI: HC$3.00/MF$0.65

The five-dimensional quasispin formalism is used to factor out the n, T-dependent parts of shell model matrix elements in the seniority scheme and derive reduction formulae which make it possible to express matrix elements for states of definite isospin T in the configuration j exp. n in terms of the corresponding matrix elements for the configuration j exp. v. The n, T-dependent factors for one and two nucleon c.f.p.s, and for the matrix elements of one-body operators and the two-body interaction are expressed in terms of generalized R(5) Wigner coefficients. The needed R(5) Wigner coefficients are calculated in the form of general algebraic expressions for the seniorities v and reduced isospins t corresponding to the simpler R(5) irreducible representations. In this first contribution the R(5) representations (omega sub 1 t) = (j+1/2-1/2v, t) are restricted to (omega sub 1 0), (omega sub 1 1/2), (tt), and the states of (omega sub 1 l) with n-v = 4k-2T, (k = integer). Explicit expressions are given for the diagonal matrix elements of the general charge independent two-body interaction and the iso-vector and iso-tensor parts of the Coulomb interaction for seniorities v = 0 and 1, and the v = 2 states with n = 4k+2-2T. Author (TAB)

N67-26680# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.

ELECTROMAGNETIC PULSE PROPAGATION IN THE NORMAL TERRESTRIAL WAVEGUIDE ENVIRONMENT

J. Ralph Johler Dec. 1966 44 p refs

(IER-21-ITSA-21; AD-648001) CFSTI: HC$3.00/MF$0.65

The theoretical problem of predicting the effect of the propagation medium on the form or shape of the low frequency electromagnetic pulse of nuclear origin has been discussed in a previous paper. This paper presents some greater detail on this remarkable propagation phenomenon. Particular emphasis is placed on the construction of transforms (amplitude and phase of the propagation medium as a function of frequency) which can be employed to propagate theoretically almost any pulse shape. The distinctive features of the propagated pulse at great distance from the source can be identified with particular reflection regions of the ground and the ionosphere along the path between the source and the observer. Author (TAB)

N67-26770# California Univ., Berkeley. Lawrence Radiation Lab.

FLUCTUATIONS OF ENERGY LOSS BY HEAVY CHARGED PARTICLES IN THIN ABSORBERS

Howard D. Maccabee, Mudundi R. Raju, and Cornelius A. Tobias *In its* Biol. and Med. 1966 p 82–86 refs (See N67-26761 14-04)

In a thin absorber (one in which the total energy lost is small compared to the kinetic energy of the particle), the probable number of large-energy-loss collisions may be so small that the random statistical fluctuations in this number result in significant fluctuations in the energy lost in this mode, and thus fluctuations in the total energy transfer will occur. This phenomenon was theoretically investigated by Landau, Symon, Vavilov, et al. In Vavilov's exact treatment, the dimensionless parameter κ is introduced, and it is shown that for $\kappa << 1$ the fluctuations are large, while for $\kappa >> 1$, the fluctuations are negligible, and the normal gaussian shape of the total energy loss distribution is valid. The Vavilov theory was investigated experimentally over the whole range of κ, and its implications for biological targets were determined. Results are reported from a series of experiments using 730-MeV protons and 910-MeV α particles, covering the range of κ from 0.0033 to 1.02. Measurements were made using a Li-drifted Si semiconductor with a smaller detector used as a coincidence gate to eliminate all pulses from particles passing through the edge of the analyzing detector. NSA

N67-26771# California Univ., Berkeley. Lawrence Radiation Lab.

SECONDARY-ELECTRON DISTRIBUTION FOR HEAVY IONS

Nobuo Oda and John T. Lyman *In its* Biol. and Med. 1966 p 87–96 refs (See N67-26761 14-04)

Two kinds of approaches to the δ-ray correction for heavy ions are discussed. These include the space-averaged picture and extended-track picture. The fundamental quantity for the space averaged picture is the differential flux (slowing-down spectrum) ϕ_δ (E) of δ rays. Experimental results on the low-energy part of ϕ_δ(E) are presented, that is, on the energy spectrum and the absolute

yield values. Results showed that when the velocities of primary ions are the same, the yields for each kind of ion are proportional to the total LET's and that when the velocities are different, the yield for higher velocity is higher than that for lower velocity. The discussion of several related problems suggests the importance of studies on the behavior of energy spectra of secondary electron flux. Author (NSA)

N67-26822# California Univ., Livermore. Lawrence Radiation Lab.
THE ELECTRICAL CONDUCTIVITY PRODUCED IN AIR AND OXYGEN BY AN INTENSE BEAM OF 4 MeV ELECTRONS
W. S. Barnes 17 Oct. 1966 34 p refs
(Contract W-7405-ENG-48)
(UCRL-50137) CFSTI: HC $3.00/MF $0.65

Experiments were performed in which the conductivity produced by the 4-MeV electron beam of the Astron accelerator in air and other gases was measured. From these conductivity measurements estimates were made of the attachment rate A_0 of electrons to oxygen molecules in air and oxygen. The effective values of A_0 found in the experiment varied approximately linearly with the total beam current because of experimental conditions. Calculations performed showed that this variation was at least partially caused by the effect of a cathode fall that occurred during the experiment. Values of A_0 found by extrapolating these linear trends to zero-beam current were compared with those calculated from the results of previous experiments. The values of A_0 found in pure oxygen agreed with those found previously, whereas those found in air were higher than the previous values by a factor of about two. Author (NSA)

N67-26823# California Univ., Berkeley. Lawrence Radiation Lab.
PROCEDURES FOR FINDING FISSION TRACKS IN MICA AND MYLAR
Lowell M. Kleppe and Mary Roger 25 Aug. 1966 16 p refs
(Contract W-7405-ENG-48)
(UCRL-17075) CFSTI: HC $3.00/MF $0.65

A procedure is described for recording, etching, and counting the tracks of fission fragments in mica and Mylar resulting from the neutron bombardment of various heavy elements. Sensitivity comparisons as well as annealing and etching conditions for both mica and Mylar are described in detail. Tracks of fission fragments in mica and Mylar can be used to locate uranium and thorium in thin rock sections; mica and Mylar can be used with metals as threshold detectors for neutrons of different energies. Author (NSA)

N67-26839# Los Alamos Scientific Lab., N. Mex.
SOLUTION OF THE NONLINEAR REACTOR KINETICS EQUATIONS BY CONTINUOUS ANALYTIC CONTINUATION
John C. Vigil (Ph.D. Thesis—N. Mex. Univ.) 8 Nov. 1966 137 p refs
(Contract W-7405-ENG-36)
(LA-3518) CFSTI: HC $3.00/MF $0.65

A method known as continuous analytic continuation is proposed for obtaining approximate solutions to the nonlinear reactor kinetics equations. This method is one of the most powerful methods available for obtaining approximate solutions to systems of coupled nonlinear differential equations of any order and is well suited for digital computer application. The proposed method has several advantages over other numerical methods. The most important of these advantages is that the method yields a definitive criterion for the magnitude of the time step. Furthermore, the magnitude of the time step determined from the criterion can be much larger than the prompt neutron generation time. Approximate solutions by continuous analytic continuation are compared with analytic solutions to the reactor kinetics equations for some of the few special cases in which analytic solutions are known. The agreement between the approximate and analytic solutions is excellent, and the error accumulation in the approximate method is within the limits predicted by the theory. The reactor kinetics equations can be expressed in two different forms; one based on the prompt neutron lifetime l. Solutions using the two forms of the equations are compared and found to be identical for all practical purposes. Since the equations based on Λ are simpler from a mathematical viewpoint than those based on l, it is recommended that the equations based on Λ be used in all transient analyses. NSA

N67-26889# Florida State Univ., Tallahassee. Tandem Accelerator Lab.
[RESEARCH IN EXPERIMENTAL AND THEORETICAL LOW-ENERGY NUCLEAR PHYSICS] Final Report, 1 Oct. 1965–30 Sep. 1966
R. H. Davis and N. P. Heydenburg [1966] 71 p refs
(Grant AF-AFOSR-440-66)
(AFOSR-67-0608; AD-647902) CFSTI: HC $3.00/MF $0.65

Nine research groups involving eleven faculty members have used the Tandem Van de Graaff Accelerator to advance scientific knowledge in the following areas: Isobaric Analogue states, alpha particle interactions, spectroscopy of the f7/2 shell, nucleon transfer and direct reactions, Coulomb excitation, collective excitation mechanisms, charged particle induced fission, and atomic high energy conversion processes. The study of the isobaric analogue states which was initiated at this laboratory, was the subject of an international conference held in Tallahassee in March, 1966. An active program in Theoretical Nuclear Physics is part of the tandem accelerator research program. In addition to collaboration in the design of experiments and the analysis of the results, fundamental problems in nuclear reactions were investigated by the theory group. The accelerator technology of the system was advanced during the past year with the replacement of several vacuum stations and the preliminary test of potassium vapor exchange which is especially important for the production of negative helium ions. Under optimum conditions an alpha particle beam of 0.5 micro amperes is available for experimental use. Author (TAB)

N67-26892# Franklin Inst., Swarthmore, Pa. Bartol Research Foundation.
EXPERIMENTAL NUCLEAR PHYSICS PROGRAM Annual Progress Report for 1966
24 Feb. 1967 29 p
(Contract Nonr-3777(00))
(AD-647915) CFSTI: HC $3.00/MF $0.65

Contents: Experimental nuclear physics (Generator modifications, Resonant scattering of the oxygen-16 gamma-rays by lead, Levels in Na23, Ge(Li) detectors, Incidental projects); Theoretical nuclear physics (Transition densities and form factors for nuclear dipole excitations, Neutron-proton-hole excitations in nuclei, Radiative capture of neutrons in the mass region A = 90). Airborne survey of cosmic ray intensities (Isocosms near solar minimum, Anomalous regions, Multiple events); The attenuation length of cosmic rays in the lower atmosphere (Attenuation length of the nucleonic component, Neutron multiplicity measurements, Meson attenuation length); Particle precipitation at the geomagnetic pole. TAB

N67-26962# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROPERTIES OF A FERMI-SYSTEM WITH EQUAL SPACINGS BETWEEN ENERGY LEVELS
You-wen Yu, Chung-hwa Chang, and Ming Yu 5 Dec. 1966 35 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 19, no. 8, 1963 p 483–502
(FTD-HT-66-495; TT-67-61323; AD-648883) CFSTI: HC $3.00/MF $0.65

The paper proposes a model system containing N fermions, in which each particle possesses three degrees of freedom, and the orbital angular momentum of the particles in the degenerated

state. Eigen solutions are found for this model system. Characteristics and physical features of the system are discussed. A comparison is also made with the conditions in an atomic nucleus. Results indicate that qualitatively the features of this model system are similar to the equally spaced energy levels in the atomic nucleus. Author (TAB)

N67-27040# Brutcher (Henry), Altadena, Calif.
ON THE FINITE TEMPERATURE TRANSPORT PROPERTIES OF NORMAL FERMI SYSTEMS. III. DISSIPATIVE EFFECTS IN A SIMPLE PERTURBATIVE MODEL
M. Watabe and R. Dagonnier [1966] 49 p refs
(Grant AF-EOAR-64-52)
(AD-647504) CFSTI: HC $3.00/MF $0.65

By using the general transport theory of normal many fermion system recently developed by Resibois, the collision term is calculated up to fourth order in a coupling parameter. It is shown that the higher order terms can be arranged into the form of the quasiparticle collision term suggested by Landau in the Fermi liquid theory, except for the transformation operator introduced by Resibois to connect the particle description to the quasiparticle one. Analysis is also made of the three body collision operator in transport theory from the same quasiparticle point of view to the lowest non trivial order in the coupling constant. It is shown that the anomalous terms in this operator contain the renormalization effects on the usual two body collision operator. Author (TAB)

N67-27048# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
SPECTRAL DISTRIBUTIONS IN NUCLEI
J. B. French 8 Mar. 1967 68 p refs Lectures presented at Dacca Seminar, Jan. 1967
(Contract AT(30-1)-875)
(UR-875-190) CFSTI: HC $3.00/MF $0.65

After some general remarks on nuclear models and nuclear calculations, some methods are suggested which consider, not the detailed spectrum of various quantities, but rather low moments of their distribution in energy isospin, angular momentum, and so on. It is pointed out that they are not limited by the size of vector spaces since they involve neither complete matrix-element calculations nor matrix diagonalization. They work with interactions of arbitrary complexity. Consideration is given to problems associated with nucleons distributed among a finite set of single-particle states. The following topics are considered in detail: moments and distributions, scalar moments, configuration moments, fixed-isospin moments, and seniority averaging. The paper is concluded with a discussion of further applications that are being made of present methods, of possible extensions of these methods, and of some new classes of problems that are of particular interest. L.E.W.

N67-27054# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
COMPOSITENESS CRITERION ON AN UNPHYSICAL SHEET
C. R. Hagen 13 Jan. 1967 26 p refs Submitted for publication
(Contract AT(30-1)-875)
(UR-875-181) CFSTI: HC $3.00

The renormalization of a quantized field for which there exists no corresponding particle-like excitation is discussed in general terms. Since the absence of a single particle term in the Lehmann representation of the propagator is associated with the passage of the pole which represents the discrete state contribution through the elastic threshold, one can continue to carry out mass and wave function renormalization in the usual way by following the motion of the relevant pole to an unphysical sheet. It is shown that this leads to a definition of Z_3 for virtual states which allows it to be negative and unbounded, a circumstance which is in sharp contrast to the corresponding result for physical particles. The Z=0 limit is discussed, it being demonstrated that an elementary virtual particle becomes a composite virtual particle in that limit. Author

N67-27055# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
REGGE POLE AND GENERALIZED ALGEBRA OF CURRENTS
Susumu Okubo 4 Jan. 1967 17 p refs Presented at the 4th Symmetry Conf., Coral Gables, Fla.
(Contract AT(30-1)-875)
(UR-875-179) CFSTI: HC $3.00/MF $0.65

An attempt was made to combine the idea of the Regge pole with that of the algebra of currents by generalizing the latter concept to commutation relations on the light cone from the conventional equal-time commutators. Consideration is first given to the quark model in which the pseudoscalar density and vector current density are given in terms of the quark field. It is pointed out that in this first example the equal-time commutation relation does not determine the behavior of the commutator on the light cone. After examining a scattering amplitude problem, consideration is given to investigating the connection between the theory proposed and the Regge pole model. Finally, the technique is applied to the mass formula in the unitarity symmetry model. L.E.W.

N67-27056# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
PRECISE MEASUREMENT OF THE K^+/K^- AND π^+/π^- LIFETIME RATIOS
F. Lobkowicz, A. C. Melissinos, Y. Nagashima, S. Tewksbury, H. Von Briesen, Jr. et al 20 Jul. 1966 12 p refs Submitted for publication
(Contract AT(30-1)-875)
(UR-875-152) CFSTI: HC $3.00/MF $0.65

An experiment designed to measure the ratio $\tau(K^+)/\tau(K^-)$ is described in detail. Measurements were made of the kaons in a well collimated beam that do not decay over a distance ranging from one to three lifetimes. The kaons were defined at the triple focus by two differential Cerenkov counters, and measurements were performed at 1.6 and 2.0 BeV/c with a momentum resolution of $\pm 0.75\%$. Before and after each alteration of the beam polarity the momentum was measured by a bending magnet and a counter. In order to check the efficiency of the beam transport system, the attenuation of protons was measured before and after every K lifetime measurement. Altogether 14 alterations of beam polarity were made and 5×10^7 kaons were counted. The final attenuations were treated by (1) forming the positive/negative ratios for each momentum and each counter and (2) fitting the final attenuations at each station to a semi-log plot to find out the best value for the lifetime. In conclusion, the results were interpreted as confirming the equality of the K^+ and K^- total decay rates at the level of 1/1000 and of the π^+ and π^- total decay rates at the level of 4/1000. L.E.W.

N67-27120# Instituto de Invesitgacion Aeronautica y Espacial, Buenos Aires (Argentina).
DETERMINATION OF THE THREE CONVERSION COEFFICIENTS IN THE DECAY OF Au^{198} WITH SEMICONDUCTOR COUNTERS
H. E. Bosch and E. Szichman (Consejo Nacl. de Invest. Cient. y Tec., Arg.) Dec. 1966 19 p refs
(Grant DA-ARO-49-66-G121)
(LR-15; AD-648754) CFSTI: HC $3.00/MF $0.65

A set-up for determining conversion coefficients by means of different arrangements with semiconductor detectors (both lithium-drifted silicon and germanium) and scintillation counters is presented. The conversion coefficients corresponding to the three transitions in Hg198 were measured. Single electron conversion and gamma-ray spectra were recorded deriving the value of the conversion coefficient for the 1.083-MeV transition, taking into

account the value obtained for that of the 0.412-MeV transition. Beta continuum-electron conversion coincidences have been performed with two lithium-drifted silicon detectors and the K-conversion coefficient for the latter transition was obtained. Gamma-gamma coincidences with a lithium-drifted germanium detector and a conventional scintillation counter were done, yielding the value of the K-conversion coefficient for the 0.671-MeV transition. Author (TAB)

N67-27131 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ELECTRON–POSITRON PAIR CREATION IN PION–NUCLEON INTERACTIONS
J. P. Loubaton and J. Tran Thanh Van Feb. 1967 8 p refs
(TH/190)

Electron–positron pairs at large angle have been found in the experiments: $\pi+$ nucleon $\rightarrow$ nucleon + $e^+ + e^-$ and δ + nucleon $\rightarrow \pi + n$. The differential cross section for pair production can be very simply related to the transverse and longitudinal inverse pion production with a virtual photon as the evaluation of differential cross section and total cross section for pair production shows. G.G.

N67-27134# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
QUASI-FREE SCATTERING EXPERIMENTS AND THE CALCULATION OF SINGLE PARTICLE ENERGIES IN NUCLEI
U. Amaldi, Jr. 16 Jan. 1967 48 p refs
(ISS-67/2) CFSTI: HC$3.00/MF$0.65

Quasi-free scattering experiments are discussed from the point of view of the measurement of nuclear separation energies and the results obtained with (p, 2p) and (e, e'p) reactions are summarized. The present theoretical situation of the calculations of these separation energies in finite nuclei is reviewed and the available results are compared with the experimental data. Author

N67-27198# Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik.
A DETERMINATION OF THE CENTER OF GRAVITY OF A PARTICLE SHOWER USING A SCINTILLATOR-DOUBLE-WEDGE [BESTIMMUNG DES SCHWERPUNKTES VON TEILCHENSCHAUERN MIT HILFE DER DOPPELKEIL-METHODE]
K. Pinkau, C. Reppin, and V. Schoenfelder Sep. 1966 32 p refs in GERMAN; ENGLISH summary
(BMwF-FB-W-66-03) Available from Zentralstelle fuer Luftfahrtdokumentation und Inform. (ZLDI), Munich: 6.40 DM

Using scintillators in the shape of a double-wedge, the center of gravity of a shower of particles (cascade axis, beam of particles) can be determined by the quotient of one signal to the sum of both. Measurements on electron showers are reported in which the cascade axis could be determined to within about $\times 0.6$ cm over a distance of 12 cm. This fairly large error is probably due to the fact that very important statistical processes (energy loss, photoelectron statistics) occur independently in each wedge of the double-wedge. In principle, it appears that much better core location can be achieved, for example, with proportional counters using high resistance wires, as has been shown for single particles, since then the fluctuations are common to both signal receivers. Author

N67-27211# California Univ., Los Angeles. Dept. of Physics.
PHOTOPRODUCTION OF π° FROM HYDROGEN NEAR THE SECOND AND THIRD PION–NUCLEON RESONANCES
Calvin Bruce Ward (Ph.D. Thesis) 1966 114 p refs Supported by NSF

Measurements of the differential cross section for the process $\gamma + p \rightarrow \pi^\circ + p$ have been made at eight pion center-of-mass angles in the range 51° to 135° and for incident laboratory photon energies of approximately 600 to 1200 MeV. Both the recoil proton and one gamma ray from the decay of the π° were detected. The incident photon energy was determined by measuring the laboratory angle and time-of-flight of the recoil proton. The angular distributions obtained were consistent with those expected from a combination of multipoles with no important contribution from vector meson exchange processes. The simplest interpretation of the angular distributions obtained in the region of the third pion–nucleon resonance required that both the magnetic quadrupole and the magnetic octopole transition amplitudes be resonant at the third pion–nucleon resonance. This result agrees with the phase-shift analysis of pion nucleon elastic scattering. Author

N67-27225*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELASTIC AND INELASTIC SCATTERING OF 42-MeV ALPHA PARTICLES FROM EVEN TELLURIUM ISOTOPES
Regis F. Leonard, William M. Stewart, and Norton Baron Washington, NASA, May 1967 31 p refs
(NASA-TN-D-3991) CFSTI: HC$3.00/MF$0.65 CSCL 20H

Angular distributions were measured for alpha elastic and inelastic scattering with isotopically enriched targets of tellurium 122, 124, 126, 128, and 130 by using the 42-MeV alpha beam of the NASA 60-inch cyclotron. In each isotope, three excited states exhibited relatively large cross sections. These were the one-phonon quadrupole state, the two-phonon state with spin and parity 4^+, and the one-phonon octupole state. Several other states were excited in each isotope but with cross sections that were too small to allow determination of very reliable excitation energies or differential cross sections. The elastic angular distributions were analyzed by using the optical model with a four-parameter Woods–Saxon potential and the Blair sharp cutoff model. Optical model fits have been obtained for a wide range of values of optical model parameters. All potentials that give a satisfactory fit to the experimental data are nearly identical at their outer edges, although they vary widely in the interior of the nucleus. Sharp cutoff fits are typical of the type usually obtained. Inelastically scattered groups of alpha particles were analyzed by using a distorted wave Born approximation. These calculations yield excellent shape fits to the inelastic differential cross sections and allow the determination of deformation parameters that are in agreement with those measured by other methods. Author

N67-27246# Argonne National Lab., Ill.
SNARG-1D, A ONE-DIMENSIONAL, DISCRETE-ORDINATE, TRANSPORT-THEORY PROGRAM FOR THE CDC-3600
G. J. Duffy, H. Greenspan, S. D. Sparck, J. V. Zapatka, and M. K. Butler Jun. 1966 61 p refs
(Contract W-31-109-ENG-38)
(ANL-7221) CFSTI: HC$3.00/MF$0.65

The computer program SNARG-1D, which is based on the S_n discrete-ordinates method and is written for the solution of one-dimensional problems using the order n = 2, 4, 6, 8, 10, 12, 16, or 32, is described. The program is applicable to plane, cylindrical, and spherical geometries. The real or adjoint solution can be calculated, and homogeneous (eigenvalue) or inhomogeneous (external source) problems can be solved. NSA

N67-27248# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
RESEARCH ON PREFERENTIAL ORIENTATION IN NUCLEAR MATERIALS BY MEANS OF X-RAY AND NEUTRON DIFFRACTION [RICERCHE SULL'ORIENTAMENTO PREFERENZIALE IN MATERIALI NUCLEARI MEDIANTE DIFFRAZIONE DI RAGGI X E NEUTRONICA]

M. Domenici and H. Walther 1967 27 p refs In ITALIAN Presented at Convegno Sullo Stato di Avanzamento delle Ricerche nel Settore: Strutturistica Chimica Diffrattometrica, Rome, 16–18 Jan. 1967
(SORIN-103)

Textures of nuclear reaction materials are studied through X-ray diffraction, and neutron diffraction techniques. Both fiber textures and sheet textures are inspected by chrystallography. Pyrocarbon and uranium diffusion materials were studied and treated at various temperatures. Brief details are also presented on diffusion barriers and fission products in the Dragon reactor.
Transl. by R.Ll.

N67-27253# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy).
STUDY OF THE ABSORPTION IN WATER OF PHOTONEUTRONS OF ENERGY GREATER THAN 50 MeV [STUDIO DELL'ASSORBIMENTO DI FOTONEUTRONI DI ENERGIA MAGGIORE DI 50 MeV IN ACQUA]
M. A. Locci, M. Pelliccioni, P. Picchi, and G. Verri 3 Feb. 1967 9 p refs In ITALIAN *Its* Nota Interna No. 347
(LNF-67/5) CFSTI: HC $3.00/MF $0.65

For application to thickness requirements of the Frascati linear accelerator, the cascades generated by higher nuclear energy were studied. Mathematical and physical parameters are briefly outlined, and a description of the cascade multiplication process is presented. Energies higher than 50 MeV are emphasized.
Transl. by R.Ll.

N67-27321# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Rutherford High Energy Lab.
IPSO FACTO: A PROGRAM FOR CALCULATING BEAM ACCEPTANCE
N. M. King and P. W. Simpson Jun. 1965 20 p refs
(RHEL-R-103) CFSTI: HC $3.00/MF $0.65

Ipso Facto is an Atlas Fortran program for computing acceptance as a function of momentum in high energy particle beams. Its chief features are outlined, and a detailed guide to its use is given.
Author (NSA)

N67-27322# North Carolina State Coll., Raleigh. Dept. of Mechanical and Aerospace Engineering.
EFFECTS OF GEOMETRY FOR DEPOSITION OF RADIOACTIVE MOLECULES FROM STAGNANT GAS IN CONTAINMENT VESSELS Progress Report
Necati M. Ozisik and Paul C. Y. Chen Aug. 1966 38 p refs
(Contract AT(40-1)-3414)
(ORO-3414-2; PR-2) CFSTI: HC $3.00/MF $0.65

Effects of geometry on deposition of radioactive molecules from stagnant gas to the vessel walls are theoretically investigated for three different geometries: parallel plates, long cylinder and sphere. In formulating the boundary value problem, it is assumed that the diffusion flux in the immediate vicinity of the wall surface is proportional to the concentration of radioactive molecules in the gas; and the effects of removal of molecules from the wall surface are also included in the boundary condition. Finite integral transform technique is employed to reduce the coupled partial differential equations to a single integral equation. For perfect sink condition at the wall surface analytical solutions are obtained. For imperfect sink condition, the integral equation is represented in the finite difference form, which is then solved with a digital computer for the concentration of radioactive molecules deposited on the wall surface. The general formulation of the problem for the three different geometries investigated are all represented in the same form, but they differed only through the eigenvalues for use in these relations. It happens that the eigenvalues for parallel plates are the lowest, and for sphere the highest. Thus, the quantity of deposition at any time for these three different geometries having the same characteristic length is highest for the parallel plates, and lowest for the sphere, the long cylinder having a value between them. Theoretical results of long cylinder model were compared with the experiments obtained from the deposition test performed in a Nuclear Safety Pilot Plant at the Oak Ridge National Laboratory. The agreement between the theory and the experiment was acceptable.
Author (NSA)

N67-27336# Oak Ridge National Lab., Tenn.
PRESSURE DEPENDENCE OF THE ENERGY OF THE RESONANCE GAMMA RAY OF Au-197 AND THE HYPERFINE STRUCTURE COUPLING OF Au-197
D. O. Patterson (Ph.D. Thesis—Tenn. Univ.), Louis D. Roberts, J. O. Thomson, and R. P. Levey Jan. 1967 114 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1685) CFSTI: HC $3.00/MF $0.65

The pressure dependence of the Mossbauer isomer shift of ^{197}Au was measured at 4.2°K to a pressure of 70.6 kilobars. The shift with respect to metallic gold at zero pressure was fit by the parabola $v_I = 3.78\times10^{-3}\ P - 5.6\times10^{-6}\ P^2$ where v_I is in mm/sec and P is in kilobars. This result is in excellent agreement with that predicted by Roberts et al. The result confirms that in all the gold alloys thus far studied the electronic charge density near the gold nucleus is greater than it is in metallic gold. The hyperfine structure coupling of ^{197}Au in ordered $AuMn_3$, $AuMn$, Au_2Mn, Au_3Mn, Au_4Mn and solutions containing 0.3 and 1 atomic per cent gold in manganese was measured. The results reflect the crystalline and magnetic structure for the different systems. Values are given for the magnetic field, electric field gradient, and isomer shift for ^{197}Au in the alloys. From the ground state splitting in Au_2Mn, the value of the magnetic moment of the 77.345-keV excited state of ^{197}Au was determined to be $\mu = 0.420 \pm 0.004$ nuclear magnetons. The hyperfine structure coupling of ^{197}Au in Au_2Mn was also studied at 15.4 and 31.1 kilobars. The isomer shift and magnetic field at the gold nucleus increased with pressure.
Author (NSA)

N67-27341# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
SMALL ANGLE ELECTRON PROTON ELASTIC SCATTERING CROSS SECTIONS FOR MOMENTUM TRANSFERS BETWEEN 10 AND 105 F^{-2}
W. Bartel, B. Dudelzak, H. Krehbiel, J. M. Mc Elroy, U. Meyer-Berkhout et al Jul. 1966 14 p refs
(DESY-66/20) CFSTI: HC $3.00/MF $0.65

A report is presented on the results of an electron–proton scattering experiment in which the elastic scattering cross section for momentum transfers between 10 and 105 F^{-2} was measured with a precision of about 5%.
NSA

N67-27344# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
INVESTIGATION OF γ-SPECTRA OF ^{75}Se, ^{106}Rh, ^{110m}Ag, ^{124}Sb, ^{125}Sb, ^{140}Ba, ^{140}La, AND ^{154}Eu [ISSLEDOVANIE γ-SPEKTROV ^{75}Se, ^{106}Rh, ^{110m}Ag, ^{124}Sb, ^{125}Sb, ^{140}Ba, ^{140}La I ^{154}Lu]
1966 73 p refs In RUSSIAN
(JINR-P6-2986) CFSTI: HC $3.00/MF $0.65

Gamma spectra of ^{75}Se, ^{106}Rh, ^{110m}Ag, ^{124}Sb, ^{125}Sb, ^{140}Ba, ^{140}La, and ^{154}Eu were investigated by using a Ge(Li) spectrometer with a volume of 5 cm^3 and drift thickness of 6 mm. Relative intensities and the multipolarities of γ transitions observed were determined. These data allowed in some cases specification of the decay mode and log ft values for different levels.
Author (NSA)

N67-27346# IIT Research Inst., Chicago, Ill.
PROMPT GAMMA RAYS FROM RADIATIVE CAPTURE OF THERMAL NEUTRONS, VOLUMES 1–2

R. C. Greenwood and J. H. Reed 14 Oct. 1965 906 p refs
(Contract AT(11-1)-578)
(IITRI-578P11-53, Vol. 1–2) CFSTI: HC$3.00/MF$0.65

An atlas of thermal neutron capture gamma-ray spectra measured under standard conditions using NaI(Tl) scintillation detectors and a comprehensive compilation of the neutron capture gamma-ray data which were available prior to May 1965, are presented. Included are prompt gamma-ray spectra and data from 74 naturally occurring elements, together with a number of separated isotopes, unstable elements, and fissionable materials. The objective of the report is to provide sufficient data concerning neutron capture gamma-ray spectra to allow evaluation of practical uses of an analytical technique based upon the detection of neutron capture gamma rays in measurement, analysis, and control technology and thereby to facilitate the use of the method in these areas. Author (NSA)

N67-27375*# Queens Univ., Belfast (Northern Ireland). Dept. of Applied Mathematics.
CALCULATIONS OF HIGHER ORDER COLLISION INTEGRALS Quarterly Status Report, 1 Jan.–31 Mar. 1967
F. J. Smith 31 Mar. 1967 5 p ref
(Contract NSR-52-112-001)
(NASA-CR-84416) CFSTI: HC$3.00 CSCL 20H

It is reported that a computer program for the repulsive power inverse potentials of the collision integrals was run, and that program logic was changed to account for the negative screened Coulomb potential. C.T.C.

N67-27444# Oak Ridge National Lab., Tenn.
DEVELOPMENT OF SHIELDING CALCULATION METHODS AT THE ATOMIC ENERGY COMMISSION (FRANCE)
C. Devillers, P. Lafore, and J. Rastoin Apr. 1966 13 p refs
Transl. into ENGLISH of Comm. a l'Energie Atomique Rept. No. DEP/SEPP-485/66
(ORNL-TR-1381) CFSTI: HC$3.00/MF$0.65

The Monte Carlo method can be applied to all problems of reactor shielding. Certain constraints for graphite and heavy water power reactors, fast reactors, light water reactors, and radiation leaks must be resolved. Computer programs used for solving these problems are discussed. NSA

N67-27447# Brown Univ., Providence, R. I. Dept. of Physics.
ANALYTICITY PROPERTIES AND ASYMPTOTIC BEHAVIOR OF SCATTERING AMPLITUDE
Y. S. Jin Feb. 1967 25 p refs
(Contract AT(30-1)-2262)
(NYO-2262TA-146) CFSTI: HC$3.00/MF$0.65

Recent developments in the study of analyticity properties of the scattering amplitude in local field theory and some immediate applications of these properties in order to obtain asymptotic behavior are reviewed. Fixed dispersion relations and the Lehmann ellipse, an extension of the analyticity domain, and asymptotic behavior are considered. NSA

N67-27448# Brown Univ., Providence, R. I. Dept. of Physics.
FUNCTIONAL METHODS FOR SOFT PHOTONS AND SOFT PIONS
H. M. Fried Feb. 1967 25 p
(Contract AT(30-1)-2262)
(NYO-2262TA-147) CFSTI: HC$3.00/MF$0.65

Practical aspects of a class of no-recoil approximations to the equations of quantum field theory are considered. The topics discussed are functional preliminaries, soft photons in quantum electrodynamics, and soft mesons (π) in ps–ps theory. NSA

N67-27451# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
SHELL MODEL PREDICTION OF THE EXCITED STATES OF He^4
Paul P. Szydlik and R. J. Philpott (Calif. Univ., Davis) [1966] 7 p
Presented at the Ann. Meeting of the Am. Phys. Soc., New York
Prepared in cooperation with Calif. Univ., Davis
(Contracts AT(11-1)-GEN-10; W-31-109-ENG-52)
(KAPL-P-3308; CONF-670109-2) CFSTI: HC$3.00/MF$0.65

Calculations were performed using the shell model and the random-phase approximation to predict the excited states of ^{4}He. The results were compared with experimental observations. The effects of varying the single-particle energies and the oscillator parameter were investigated, and the differences between energy levels as predicted by the random-phase approximation and the Tamm–Dancoff approximation were determined. NSA

N67-27452# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
MESON–BARYON SCATTERING AND SU(6) GROUP [MEZON–BARIONNOE RASSEYANIE I SU(6)]
A. N. Zaslavskii and V. Tybor 1966 18 p refs In RUSSIAN
(JINR-P2-3087)

A comparison is made with the experiments on meson–baryon scattering of those predictions of the SU(6) group which remain valid in the framework of the relativistic $SU_x(6)$ group. Although in certain cases there is an agreement, on the whole a sharp divergence is observed in the momentum region up to 4 GeV/c. Author (NSA)

N67-27453# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SMALL-ANGLE SCATTERING AND A LOWER BOUND FOR THE SCATTERING AMPLITUDE AT LARGE ANGLES [RASSEYANIE NA MALYE UGLY I NIZHNYAYA GRANITSA UBYVANIYA AMPLITUDY V OBLASTI BOL'SHIKH UGLOV]
A. A. Logunov and M. A. Mestvirishvili 1967 10 p refs In RUSSIAN Submitted for publication
(JINR-P2-3139)

A relation is established between the lower bound for the large-angle scattering amplitude and the behavior of the diffraction and of the backward scattering peak widths. Author (NSA)

N67-27454# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ALGORITHM ALLOWING TO FIND EIGENFUNCTIONS AND EIGENVALUES OF THE ENERGY OPERATOR FOR SOME VARIANTS OF QUANTUM FIELD THEORY [ALGORITM, POZVOLYAYUSHCHII NAITI SOBSTVENNYE FUNKTSII I SOBSTVENNYE ZNACHENIYA OPERATORA ENERGII DLYA NEKOTORYKH VARIANTOV KVANTOVOI TEORII POLYA]
L. G. Zastavenko 1967 9 p refs In RUSSIAN
(JINR-P2-3112)

A constructive method for calculation of the energy operator eigenfunctions and eigenvalues fit for the whole class of quantum field theory variants is given. The method is illustrated by the example of a neutral scalar field with the $g\phi^4$ selfaction. Author (NSA)

N67-27455# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
FOUR-DIMENSIONAL UNITARY RELATIVISTIC MODEL OF QUANTUM FIELD THEORY WITHOUT DIVERGENCES [CHETYREKHMERNAYA UNITARNAYA RELYATIVISTSKAYA MODEL KVANTOVOI TEORII POLYA BEZ RASKHODIMOSTEI]

M. K. Volkov 1967 17 p refs In RUSSIAN Submitted for publication
(JINR-P2-3114)

The Green functions and the scattering amplitude of scalar particles are investigated in the four-dimensional relativistic Bialynicki–Birula's model. It is shown that the ultraviolet divergences are absent and the condition of the unitarity of the S-matrix is fulfilled in the second order of the perturbation theory with an expansion in Δm (nucleon mass difference in two possible states). Author (NSA)

N67-27458# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
TO THE QUANTUM THEORY OF SCALAR FIELD WITH $G\phi^4$ SELF-ACTION IN THE CASE OF ONE SPATIAL DIMENSION [K KVANTOVOI TEORII SKALYARNOGO NEITRAL'NOGO POLYA S SAMODEISTVIEM $G\phi^4$ V SLUCHAE ODNOI PROSTRANSTVENNOI STEPENI SVOBODY]
L. G. Zastavenko 1967 9 p refs In RUSSIAN
(JINR-P2-3113)

A formulation of a relativistic model in quantum field theory, which is not based on the theory of perturbations, is given. Author (NSA)

N67-27459# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
OBSERVATION OF THE (e^+e^-) DECAY MODES OF NEUTRAL VECTOR MESONS
M. A. Azimov, A. M. Baldin, A. S. Belousov et al 1967 26 p refs
(JINR-E1-3148)

The cross sections of (e^+e^-) pair production were measured in the reactions $\pi^-+p \rightarrow V^0+n$, $V^0 \rightarrow e^+e^-$ at P=4.0 GeV/c using a system of jointly operating spark chambers and Cherenkov total absorption γ-spectrometers. In contrast to earlier techniques the apparatus made it possible to measure both the opening angles and the energies of the V^0-particle decay products and, hence, to determine its effective mass in each event. There were 13 events detected and identified as the $\rho \rightarrow e^+e^-$ and $\omega \rightarrow e^+e^-$ decays and one $\phi \rightarrow e^+e^-$ event. From the cross sections obtained and total cross sections for ρ, ω, and ϕ mesons known two independent determinations of the width of the vector meson octet decay into e^+ and e^- were made: $\Gamma(V_8 \rightarrow e^+e^-) = (0.45\pm0.14)\cdot10^{-2}$ MeV; $\Gamma(V_8 \rightarrow e^+e^-) \leq 2.6\cdot10^{-2}$ MeV, which corresponds to probability ratios: $\Gamma(\rho \rightarrow e^+e^-)/\Gamma(\rho) = (0.39\pm0.12)\cdot10^{-4}$; $\Gamma(\omega \rightarrow e^+e^-)/\Gamma(\omega) = (0.48\pm0.15)\cdot10^{-4}$; and $\Gamma(\phi \rightarrow e^+e^-)/\Gamma(\phi) \leq 2.10^{-3}$. The value $\theta = 38°$ was used for the ω–ϕ mixing angle. Author (NSA)

N67-27483# Brookhaven National Lab., Upton, N. Y.
SOME ASPECTS OF TARGETING SYSTEMS FOR A SLOW EXTRACTED BEAM AT THE AGS
A. L. Read 30 Jan. 1967 10 p
(Contract AT(30-2)-GEN-16)
(BNL-11034) CFSTI: HC $3.00/MF $0.65

Some possible beam handling arrangements at targeting stations for the slow extracted beam which is to be developed at the AGS are considered. Some problems are discussed relevant to production of secondary particle beams, which are peculiar to external proton beams, and have not been encountered during the use of the F-10 and G-10 internal target areas. NSA

N67-27484# Brookhaven National Lab., Upton, N. Y.
THEORY OF LONGITUDINAL INSTABILITIES IN SYNCHROTRONS, WITH APPLICATIONS
Robert L. Pease 16 Dec. 1966 24 p refs
(Contract AT(30-2)-GEN-16)
(BNL-11041) CFSTI: HC $3.00/MF $0.65

By combining the results of longitudinal instability theory and synchrotron oscillation theory, it is possible to derive two simple and useful expressions for longitudinal instability particle threshold. The first, which holds at injection, is given directly in terms of design parameters; in practical cases it turns out to depend only slightly on injection energy and to be independent of field index and vacuum chamber size, provided only that the vacuum chamber is large enough to contain particle oscillations. The second, which is based on adiabatic bunch behavior, displays the variation of threshold with energy; it decreases monotonically from injection to transition (if a real transition exists) and then increases monotonically. Different regions of this universal curve are relevant, depending upon whether the machine considered is a booster, a weak-focussing machine or a standard AG synchrotron in which transition is crossed. Practically, it appears that recently proposed boosters will be free from longitudinal instabilities if a little care is exercised in design. It is quite evident that proposed improved AG machines will have no problems at injection; the treatment of the transition region is still crude, and further analysis will be required for a definite answer—it appears that there might be trouble at least in Phase II (2×10^{13} protons) unless the capture at injection is extremely efficient. Author (NSA)

N67-27485# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires
SINGLE PION AND SEVERAL PIONS PRODUCTION IN π^+p INTERACTIONS AT 1.6 GeV/c [CREATION D'UN ET PLUSIERS MESONS π DAN LES INTERACTIONS π^+p A 1.6 GeV/c]
Marie-Antoinette Jabiol (Ph.D. Thesis—Paris Univ.) 8 Jun. 1966 75 p In FRENCH
(CEA-R-3036)

The production of ρ^+, N^*_{33} and η^0 was observed in π^+p interactions at 1.6 GeV/c. In the reactions where one pion is created, the comparison between the experimental distribution of the ρ^+ and the N^*_{33} with the predictions of the peripheral model modified by absorption effects permits the conclusion that the contribution of this model is important, but that other effects such as interferences between ρ^+ and N^*_{33} are not negligible. In the reactions where several pions are created, the branching ratios of some decay modes of η^0 are evaluated and the associated production of η^0 and N^*_{33} is observed. Author (NSA)

N67-27490# European Organization for Nuclear Research, Geneva, (Switzerland).
PROCEEDINGS OF THE 1966 CERN SCHOOL OF PHYSICS, NOORDWIJK AAN ZEE, JUNE 6–18, 1966
J. J. De Swart, J. C. Sens, and R. Kronig 20 Dec. 1966 152 p refs
(CERN-66-29, Vol. 2)

A discussion of the symmetries of strong interactions is given and includes quarks, unitary symmetry, group representations, irreducible representations, Clebsch–Gordan coefficients, irreducible tensor operators, the mass formula, and coupling constants. Also considered are weak interactions, SU(2) group, mesons in SU(6), and baryons. Aspects of meson (μ) physics are discussed. These include meson (μ) capture, the phenomenology of meson (μ) decay, meson (μ)–electron universality, and meson (μ) static properties. Symmetry and asymmetry in physics is also discussed. NSA

N67-27497# Wisconsin Univ., Madison.
ISOTOPIC SPIN DECOMPOSITION OF THE AMPLITUDES FOR $K \rightarrow 2\pi$
David Cline Jan. 1967 10 p
(Contract AT(11-1)-881)
(COO-881-96) CFSTI: HC $3.00/MF $0.65

The possibility of determining the magnitudes and phases of the amplitudes for isotopic spin transitions $\Delta T = I/2$ where I = 1, 3, and 5 is discussed. It is found that such a decomposition is possible provided that the phase angle of the amplitude for $K^+ \rightarrow \pi^+ + \pi^0$ can be measured. The possibility of measuring this

phase angle using the decay modes $K^{\pm} \rightarrow \pi^{\pm}\pi^{0}\gamma$ is discussed. Finally, a set of amplitudes is suggested that are consistent with all experimental data and which exhibit nearly maximal CP violation for the $\Delta T=3/2$ and 5/2 amplitudes. NSA

N67-27498# California Inst. of Tech., Pasadena. Synchrotron Lab.
PION PHOTOPRODUCTION DATA BELOW 1.5 GeV
J. T. Beale, S. D. Ecklund, and R. L. Walker 1 Nov. 1966 120 p refs
(Contract AT(11-1)-68)
(CALT-68-108) CFSTI: HC $3.00/MF $0.65

Data on single pion photoproduction below 1.5 GeV were collected and are presented in the form of tables and graphs. The compilation is mostly noncritical, and the numbers are those contained in the original papers. Data from different experiments were not normalized in order to obtain agreement from one experiment to another. The tables of data presented are meson (π^{+}) and meson (π^{0}) differential cross sections, meson (π^{-}) data, polarized photon asymmetries, and recoil polarization. The graphs include meson (π^{+}) angular distributions, meson (π^{0}) angular and energy distributions, meson (π^{-}) angular distributions, total and differential cross sections at 0 and 180°, and polarized photon asymmetries and polarization of the recoil nucleon. NSA

N67-27554# Production Group, United Kingdom Atomic Energy Authority, Annon (Scotland). Health and Safety Dept.
THERMAL NEUTRON DEPTH DOSE DEPENDENCE ON BEAM AND PHANTOM SIZE FOR INCIDENT COLLIMATED BEAMS OF FAST NEUTRONS
R. C. Lawson and D. E. Watt 1967 19 p refs
(PG-774(CC)) CFSTI: HC $3.00

Thermal neutron flux distributions produced at depth in tissue-equivalent liquid were measured for several collimated beams of incident fast neutrons with the object of obtaining data for calculating the $^{1}H(n,\gamma)^{2}D$ and $^{14}N(n,p)^{14}C$ doses delivered under conditions experienced frequently in radiobiological experiments. It is demonstrated that two group theories can be used to predict accurately the distribution of thermal neutron flux with depth and also the position of the peak value. A simple formula is given which permits the magnitude of the peak to be determined for any beam size between 5 cm and 17 cm diameter relative to that measured for one beam size. By a combination of these formulae a complete description of the thermal neutron flux at depth in tissue can be obtained. Studies on the magnitude of the flux distribution caused by changes in the phantom dimensions lead to the conclusion that the naturally occurring statistical variations about the size of the standard man phantom do not produce an important change in dose level. Author

N67-27555# Tokyo Univ. (Japan). Dept. of Physics.
DIPOLE NATURE OF THE LEADING REGGE TRAJECTORY
Tetsuo Sawada [1966] 11 p refs
(TUEP-67-4)

From the very general assumption, it is shown that in order to be consistent with the unitarity condition the leading trajectory must be a Regge dipole with $\alpha(0) = 1$ rather than a Regge pole, the case where a Regge pole plus Regge cut is the leading one is also excluded. An inequality concerning $\sigma_{tot}(\infty)$ and $\alpha'(0)$ is also derived. Author

N67-27559# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
PHOTOPRODUCTION OF CHARGED PIONS IN A REGGE POLE MODEL
B. Diu and M. Le Bellac Feb. 1967 8 p refs
(TH/191)

With a Regge pole model based on the dominance of ρ and A_2 exchange, the cross-section for photoproduction of charged pions is related to that for vector meson production in π-nucleon collisions. Author

N67-27561*# National Aeronautics and Space Administration, Washington, D. C.
PRODUCTION OF POSITRONS BOMBARDMENT OF THICK FOILS FAST ELECTRONS [ROZHDENIYE POSITRONOV PRI PROKHOZHDENII BYSTRYKH ELEKTRONOV CHEREZ TOLSTYYE FOL'GI]
A. V. Bautin and V. M. Galitskiy May 1967 4 p refs Transl. into ENGLISH from At. Energ. (USSR) (Moscow), v. 21, no. 2, Aug. 1966 p 126–127
(NASA-TT-F-10932) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The angular distribution and outflow of photons and positrons during the bombardment of a layer of substance by fast electrons is investigated. The results obtained closely coincide with the numerical calculations. Author

N67-27582# California Univ., Livermore. Lawrence Radiation Lab.
PHOTON CROSS SECTIONS 1.0 KeV TO 15.0 MeV
Ernest F. Plechaty and John R. Terrall 20 Sep. 1966 112 p refs
(Contract W-7405-ENG-48)
(UCRL-50178) CFSTI: HC $3.00/MF $0.65

Photon cross sections from 1.0-KeV to 15.0-MeV photon energy are presented for selected elements in tabular and graphical form together with a discussion of the method of evaluation. Author (NSA)

N67-27584# California Univ., Berkeley. Lawrence Radiation Lab.
PHYSICS Semiannual Report, May–Oct. 1966
Jan. 1967 72 p refs
(Contract W-7405-ENG-48)
(UCRL-17282) CFSTI: HC $3.00/MF $0.65

Various experiments in high energy research are described. Some cosmic ray research is also included. Theoretical physics is considered including subnuclear, nuclear, and plasma physics. Accelerator operation and development is discussed. Author (NSA)

N67-27591# Idaho Nuclear Corp., Idaho Falls.
MULTIPLE SCATTERING OF THERMAL NEUTRONS
J. P. Plummer Feb. 1967 37 p refs
(Contract AT(10-1)-1230)
(IN-1045) CFSTI: HC $3.00/MF $0.65

The quantum mechanical treatment of multiple scattering developed by Watson et al. is examined and is applied to thermal neutron scattering in the static approximation. It is shown that recent efforts along similar lines appearing in the literature have been oversimplified approaches to a very complex problem. Author (NSA)

N67-27592# Argonne National Lab., Ill.
FAST-NEUTRON SCATTERING FROM ELEMENTAL Mo, Sn, Sb, AND Te
A. B. Smith and R. Hayes Nov. 1966 34 p refs
(Contract W-31-109-ENG-38)
(ANL-7274) CFSTI: HC $3.00/MF $0.65

Neutrons with incident energies of 0.3 to 1.5 MeV were scattered from elemental Mo, Sn, Sb, and Te. Fast time-of-flight techniques were employed to measure the differential elastic and the differential inelastic scattering cross sections at ≤25-KeV increments throughout the incident neutron-energy interval. The inelastic excitation of states was observed: in Mo at 0.20±0.01, 0.50±0.04, 0.79±0.06, and ≈1.05 MeV; in Sn at ≈1.2 MeV; in Sb at 0.037±0.003, 0.16±0.01, 0.54±0.04, and ≈1.1 MeV; and in Te at 0.65±0.02, 0.75±0.02, and 0.85±0.02 MeV. The experimental results were compared with calculations based upon a surface-absorption optical potential and the statistical theory of

average compound-nucleus cross sections including corrections for width fluctuations. These comparisons were related to the characteristics of the low-energy excited states of the respective nuclei and to the proton shell closure at Z=50. Author (NSA)

N67-27628# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
ON THE REGGE SYMMETRIES OF THE 3J SYMBOLS OF SU(2)
G. Flamand [1966] 17 p refs
(TH/183)

The symmetries of the 3j symbols of SU(2) are fitted into a broader group theory framework. The 3j symbols of SU(2) are identified to certain 3j symbols of SU(3). Viewed as SU(3) properties, their Regge symmetries are nothing but ordinary permutation symmetries. Author

N67-27664*# Harvard Univ., Cambridge, Mass. Dept. of Physics.
THE EFFECTS OF SCATTERING ON SMALL PROTON BEAMS
W. M. Preston and A. M. Koehler [1966] 38 p refs
(Grant NsG-262-63)
(NASA-CR-84505) CFSTI: $3.00 CSCL 20H

The limitations due to multiple Coulomb scattering on the minimum dimensions of small collimated beams of heavy charged particles are discussed. The standard deviation σ for radial scattering for protons, of energies up to 160 MeV, is calculated for water and aluminum and the results compared with a number of experimental determinations. The effect of multiple scattering on the effective Bragg ionization curve is evaluated for collimated beams of circular and rectangular cross section. Author

N67-27683# Tokyo Metropolitan Univ. (Japan). Dept. of Physics.
A NEW TREATMENT OF THE COLLECTIVE MOTION OF CHARGED PARTICLES
Tadasi Mituda [1965] 32 p refs
(NUP-67-3)

Consideration is given to a new treatment of the collective motion of charged particles, such as plasma motion. This treatment differs from the traditional treatment such as the Vlasov equation and the magnetohydrodynamical equation. Two concepts were introduced about the electromagnetic field: the microscopic field and the macroscopic field. The microscopic field behaves in a similar way as the peculiar velocity varies discretely. The macroscopic field is derived from the microscopic field by the statistical method of averaging. In this method, a distribution function, which differs from that of the conventional theory, is used, and stress tensor is defined. A macroscopic field equation differing from the usual macroscopic Maxwell equation is shown to be derivable from the subatomic or the atomic field equation introduced by de Groot. Author

N67-27690# Polish Academy of Sciences, Cracow.
PROTON MAGNETIC RELAXATION IN SOME LIQUIDS [O PROCESIE MAGNETYCZNEJ RELAKSACJI PROTONOW W NIEKTORYCH CIECZACH]
Jacek W. Hennel 1966 75 p refs In POLISH; ENGLISH summary
(INP-507/PL)

Proton spin-lattice relaxation time T_1 in the liquid state of NH_3, H_2S, and H_2S–D_2S mixture ware measured in a wide range of temperatures. In all these liquids a maximum of T_1 is found. This behavior is explained using Hubbard's theory as due to dipolar and spin-rotational interaction. Author

N67-27691# Polish Academy of Sciences, Warsaw.
SIX-PRONG INTERACTIONS OF 8 GeV/c π^+ IN HYDROGEN
Maris Bardadin-Otwinowska, Marian Danysz, Tomasz Hofmokl, Stanislaw Otwinowski, Helena Piotrowska et al Nov. 1966 16 p refs
(INR-761/VI/PH)

Cross sections for fitted reaction channels are given. Frequencies of single resonance production are calculated, and cross sections for quasi-three-body reactions are estimated. General characteristics of the emission of secondaries are compared with the results obtained at 10 GeV/v π^-p. Author

N67-27708# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
A DETAILED ANALYSIS OF NULCEON–NUCLEON COLLISIONS BETWEEN 10^{12} eV AND 10^{14} eV [SZCZEGOLOWA EKSPERYMETALNA ANALIZA ZDERZEN NUKLEON–NUKLEON POMIEDZY 10^{12} eV A ^{14}eV]
K. Rybicki Jul. 1966 49 p refs
(Rept.-734/VI/PH)

Twenty-four nucleon–nucleon collisions at the energy of 1 to 100 TeV have been analyzed in detail. Due to large dimensions of the emulsion stack the available path of secondary tracks was comparable with the interaction length. This analysis included search for electron pairs (98 found), and neutral secondary interactions (9 found). An attempt to estimate the primary energy independently of the angular distribution of the primary jet has been done. It is shown that the incident nucleon is deflected during collision in which losses average about 40% of its primary energy. In the energy region up to ~8 TeV all events can be interpreted in terms of emission of one or, more often, two fireballs. These jets can be tentatively interpreted in terms of emission of more than two fireballs. Author

N67-27747 National Bureau of Standards, Boulder, Colo. Inst. for Basic Standards.
BIBLIOGRAPHY OF LOW ENERGY ELECTRON COLLISION CROSS SECTION DATA
L. J. Kieffer 10 Mar. 1967 96 p refs
(NBS-Misc.-Publ.-289) GPO: $0.50

A bibliography of low energy electron collision cross section data is presented. Only references which report original measurements or calculations of electron collision cross sections are included. The cross section data for each process are listed by atomic species in order of their atomic number. The data for molecules are listed in arbitrary order. Author

N67-27761 Tokyo Univ. (Japan). Dept. of Physics.
FERMI–YANG MODEL FOR PION AND THE HIGH ENERGY BEHAVIOR OF π–N SCATTERING
Yasuhiko Futami and Tetsuo Sawada [1967] 4 p refs

The relation between the total cross section of $\sigma_{\pi N}$ and σ_{NN} is derived using the composite model of pion due to Fermi and Yang. The agreement with the experiments is fairly good. Author

N67-27763# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
A DISCRETE IMPACT PARAMETER REPRESENTATION OF THE SCATTERING AMPLITUDE
K. Chadan Feb. 1967 13 p refs
(TH/189)

It is rigorously shown that, contrary to what has been often used in practical applications, an exponential or faster decrease of the impact parameter amplitude, when the impact parameter becomes very large, is not allowed. The fastest allowed decrease is given by a given formula, or, more generally, by the theorem stated before it. On the other hand, the impact parameter representation formulas are found to be rigorously equivalent to an infinite discrete sum over discrete values of the impact parameter $b: b_n = n\pi/2p$, p being the momentum in the C.M. System. According to what one

is willing to admit for the asymptotic behavior of the impact parameter amplitude, one gets either of two given formulas. Author

N67-27765# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
GROUND-STATE OF LIQUID HELIUM 4 AND 3
Daniel Schiff (New York Univ.) and Loup Verlet (Yeshiva Univ.) Jan. 1967 29 p refs
(TH-185)

A variational calculation of the ground-state energy of liquid helium four and liquid helium three is made, using respectively Jastrow and Slater–Jastrow type trial wave-functions. In the boson (He^4) case, the quantum average (analogous to a statistical average over a fictitious canonical ensemble) is computed by a molecular dynamics method for a system of 864 atoms. The following quantities are obtained: ground-state energy: $-5.95^{\circ}K$/atom (experiment: $-7.14^{\circ}K$/atom); equilibrium density (0.020 ± 0.002) atoms/$Å^3$ (experiment: 0.022 atoms/$Å^3$); liquid structure factor; fraction of particles condensed in the zero-momentum state: 0.105 ± 0.005. This is in good agreement with previous computations. In the fermion (He^3) case the energy expectation value is calculated approximately by use, up to second order, of a cluster-expansion of the effect of the antisymmetrization, developed by Wu and Feenberg. The ground-state energy obtained is $-0.35^{\circ}K$/atom (experiment: $-2.52^{\circ}K$/atom). Author

N67-27777 Tokyo Univ. (Japan). Dept. of Physics.
OBSERVED MESON MASS REGULARITY AND THE 405 MULTIPLET OF SU(6)
Chiaki Itoh [1967] 8 p refs
(TUEP-67-5)

Mass operators are applied to the 35 meson multiplets, and the mass matrix was determined. An analysis of the results is presented. Some undesirable results, all indicating that $g \neq 0$ in the mathematical expressions given, are stated. A table of eigenvalues of the mass operator and possible correspondence with observed mesons is given. The results on masses for the 405 mesons (using the particle mixing equations given) are presented, and are changed from the results of the prior analysis on the 405 mesons using quadratic masses. L.S.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N67-26501*# Stanford Univ., Calif. Inst. for Plasma Research.
ELECTRON–NEUTRAL (ELASTIC) COLLISIONS IN THE METHOD OF SIMULATING ONE-DIMENSIONAL DIODES ON THE COMPUTER Final Report
Peter Burger Dec. 1966 35 p refs
(Grant NaG-299-63)
(NASA-CR-84163; SUIPR-125) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Only one-dimensional fields are considered in diodes with plane-parallel symmetry. The method used is to change the velocities of particles in a random manner according to their probabilities of suffering a collision. It is applied to the hard-sphere type of collisions between electrons and neutrals. Three examples are shown, and in two of them comparison between analytical and computer simulation results are possible. Reasonably good agreements are obtained. It is demonstrated that the inclusion of electron–neutral collisions into computer simulation procedures could be used for finding the damping effect of these collisions on the oscillatory behavior of unstable plasma diodes. With this method we can compute the large-signal, time-dependent characteristics of diodes at intermediate pressures in which the mean-free path is comparable to the diode distance. Author

N67-26562*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF CHARGED PARTICLE MOTION IN MAGNETIC TRAPS OF ACUTE GEOMETRY [ISSLEDOVANIYE DVIZHENIYA ZARYAZHENNYKO CHASTITS V MAGNITNYKH LOVUSHKAKH OSTROUGOL'NOY GEOMETRII]
K. D. Sinel'nikov, N. A. Khizhnyak, N. S. Repalov, P. M. Zaydlits, V. A. Yamnitskiy et al Feb. 1967 16 p refs Transl. into ENGLISH from the book "Fizika Plazmy i Problemy Upravlyayemogo Termoyadernogo Sinteza" Kiev, Izd. Naukova Dumka, 1965 p 388–402
(NASA-TT-F-10750) CFSTI: HC $3.00/MF $0.65 CSCL 20I

An analysis is made of the characteristics of charged-particle motion in several practically encountered axisymmetric magnetic fields of acute geometry. The specific features of particle trajectories determined by numerical integration of the equations of motion are examined. Author

N67-26563*# National Aeronautics and Space Administration, Washington, D. C.
A MAGNETIC TRAP WITH A STRONG MAGNETIC FIELD [MAGNITAYA LOVUSHKA S SIL'NYM MAGNITNYM POLEM]
Ye. S. Borovik, F. I. Busol, V. A. Kovalenko, V. B. Yuferov, and Ye. I. Skibenko Feb. 1967 11 p refs Transl. into ENGLISH from the book "Fizika Plazmy i Problemy Upravlyayemogo Termoyadernogo Sinteza" Kiev, Izd. Naukova Dumka, 1965 p 421–431
(NASA-TT-F-10754) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A method is described for injecting intense beams of fast neutral hydrogen atoms into a magnetic trap by ionizing a portion of the atoms with the aid of a strong magnetic field. It is shown that the problem of achieving and maintaining a superhigh vacuum and of creating an injector of fast neutral hydrogen atoms can be solved by using low-temperature techniques. A description is given of the magnetic system and parameters of a new magnetic trap, the vacuum chamber of the trap, and of various components of the hydrogen-atom injector. Author

N67-26564*# National Aeronautics and Space Administration, Washington, D. C.
EXPERIMENTAL STUDY OF THE MOTION OF CHARGED PARTICLES IN MAGNETIC TRAPS WITH AN ACUTE-ANGLE GEOMETRY [EKSPERIMENTAL'NOYE ISSLEDOVANIYE DVIZHENIYA ZARYAZHENNYKH CHASTITS V MAGNITNYKH IOVUSHKAKH OSTROUGOL'NOY GEOMETRII]
K. D. Sinel'nikov and B. S. Akshanov Feb. 1967 8 p refs Transl. into ENGLISH from the book "Fizika Plazmy i Problemy Upravlyayemogo Termoyadernogo Sinteza" Kiev, Izd. Naukova Dumka, 1965 p 403–410
(NASA-TT-F-10751) CFSTI: $3.00 CSCL 20I

Computer calculations of electron trajectories in electron traps with opposed magnetic fields were performed. An apparatus for the verification of the theoretical results is described. Axial spiral electron beams were produced in the experiments. Author

N67-26597*# National Aeronautics and Space Administration, Washington, D. C.
ELECTRON GAS IN A MAGNETIC FIELD [ELEKTRONNYY GAZ V MAGNITNOM POLE]
Ye. M. Lifshits May 1967 18 p ref Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 7, 1937 p 390–400
(NASA-TT-F-479) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The kinetic equation is derived for a gas consisting of charged particles in a magnetic field. This equation is used to determine the relaxation time for establishing Maxwell distribution in this gas as well as its thermoconductivity. A bundle of charged

particles—plane and cylindrical—is investigated. The dependence of the bundle width on time is determined by means of this equation. Author

N67-26823*# National Aeronautics and Space Administration, Washington, D. C.
EXPERIMENTAL STUDY OF A CLOSED MAGNETIC TRAP [EKSPERIMENTAL'NOYE ISSLEDOVANIYE ZAMKNUTOY MAGNITNOY LOVUSHKI]
A. P. Slabospitskiy and V. D. Fedorchenko Feb. 1967 7 p refs Transl. into ENGLISH from "Fizika Plazmy i Problemy Upravlyayemogo Termoyadernogo Sinteza: Doklady 4-OGO Konferentsii Po Fiz. Plazmy i Problemam Upravlyayemogo Termoyadernogo Sinteza", Kiev, 1965, p 416–421 Izdatel'stvo Naukova
(NASA-TT-F-10753) CSCL 20I

The mechanism of transferring the transverse energy of electrons into longitudinal energy within a magnetic trap is investigated. Using a closed racetrack-shaped magnetic trap with a perimeter of 10 m, electrons were injected into the trap and completed up to 25 circuits in it. Author

N67-26736# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
INVESTIGATION OF ELECTRIC ARC INTERACTION WITH AERODYNAMIC AND MAGNETIC FIELDS
W. C. Roman and T. W. Myers Oct. 1966 60 p refs
(ARL-66-0191; AD-646589) CFSTI: HC $3.00/MF $0.65

An experimental study of a balanced electric arc of 200 to 400 amperes in an atmospheric pressure cross-flow air stream of velocities up to 60 ft/sec and transverse magnetic field strengths up to 50 gauss was made. An open-jet type facility permitted the use of diagnostic techniques in the arc wake region. The arcs significant dimension transverse and parallel to the flow was measured. This dimension increased transverse to the flow and decreased parallel to the flow as the transverse blowing velocity was increased. Velocity profiles, energy flux distributions, relative turbulence levels and frequency measurements were obtained in the arc wake using miniaturized probe techniques. Flow visualization studies were performed using micron-sized particles. The input and output arc power distribution was obtained. The energy convectively transferred to the arc wake was equal to the additional electrical energy input required to maintain the arc in the presence of the transverse blowing. A drag coefficient for the arc, analogous to that of a solid cylinder subjected to a cross-flow, was defined and measured to have values between 0.7 and 1.2. Comparisons between the wake of an arc and that of a heated solid cylinder indicated similarity in vortex shedding frequency and convective heat transfer. Author (TAB)

N67-26821# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
CURRENT DISTRIBUTION TO A PLANE SHIELDED CATHODE IN THE ABNORMAL GLOW DISCHARGE
J. R. Mullaly 10 Feb. 1967 24 p refs
(Contract AT(29-1)-1106)
(RFP-792) CFSTI: HC $3.00/MF $0.65

The distribution of current over the surface of a plane shielded cathode in the abnormal glow discharge was determined for different values of voltage, pressure, anode–cathode spacing, and magnetic field. All work was done with argon at pressures of 30 microns or lower in a 12-inch diameter Pyrex glass bell jar. Metal removal is compared with current distribution. Two appendices are given; one briefly reviews abnormal glow discharge and the other gives total discharge current increase as a function of magnetic field strength. Author (NSA)

N67-26875# Illinois Univ., Urbana. Coordinated Science Lab.
KINETIC THEORY OF PLASMAS
T. J. Lie Feb. 1967 87 p refs
(Contract DA-28-043-AMC-00073(E))
(R-341; AD-648456) CFSTI: HC $3.00/MF $0.65

Based on the picture of field-particle scattering, an attempt is made to derive kinetic equations for plasmas. The system is assumed to have overall neutrality and to be under no external forces. A linear approximation which corresponds to linearizing the Vlasov equation is used to truncate the hierarchy of equations. The whole problem is reduced to exactly solving a familiar singular integral equation. A coupled set of temporal equations for the field energy and the homogeneous Fourier component of the one-particle distribution function is obtained under arbitrary initial correlations. The particle part of the equations consists of two terms: the one is the well-known Balescu-Lenard collision integral and the other is what one obtains in the quasi-linear theory of plasmas based on the Vlasov equation. The resonant scattering part of the equations agrees with the Pines-Schrieffer equations. Both the stable and unstable cases are considered, and the motions of ions is also included. The theory is valid regardless whether the system is homogeneous or non-homogeneous. Author (TAB)

N67-26878# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
ON THE USE OF VARIATIONAL METHODS IN STEADY MAGNETOGASDYNAMICS
F. Cap and G. Mueller 21 Nov. 1966 18 p refs
(Contract AF 61(052)-675)
(SR-39; AFOSR-67-0416; AD-648250) CFSTI: HC $3.00/MF $0.65

After having shown under which conditions the derivation of a potential equation is possible in magneto-gasdynamics, the derivation is discussed. Since there is a change of type at the transit from the subcritical range to the supercritical one, the variational method is the only possibility to obtain a homogeneous solution for both ranges. The variational problem which belongs to the potential equation is discussed and solved for a ratio of the specific heats of 1.5 for the flow past a cylinder. The two figures show the flow lines and the lines of the same Mach number for a cylinder with the radius of 1 m, a magnetic field of 10,000 Gauss and an initial flow velocity of 500m/sec. Author (TAB)

N67-26904# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
THE APPLICATION OF A DIFFERENTIAL INTERFEROMETER TO AN AXIALLY SYMMETRIC ARC HEATED PLASMA Final Report
Jimmy D. Lamb and Paul W. Schreiber Nov. 1966 143 p refs
(ARL-66-0222; AD-648560) CFSTI: HC $3.00/MF $0.65

The index of refraction of an argon plasma produced by a free-burning electric arc was measured by a differential interferometer. The interferometer is based upon the Wollaston prism and is easy to set up and align. One Wollaston prism splits the beam to provide path separation of the light through the arc; another Wollaston is required to produce the interference fringes. Integration of the fringe deflections and inversion of an Abel integral equation yields the index of refraction of the arc referenced to the index of refraction of the surrounding air. Theory of the interferometer and certain inherent errors of the device are presented. The data-reduction method is described and examples of raw data and results are presented. The value of refractive index minus one was found for 5463-A light. The accuracy of the method is currently limited by insufficient knowledge of the reference air temperature. Author (TAB)

N67-26936# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Thermo-Mechanics Research Lab.
ANALOG COMPUTER SOLUTION FOR THE DEVELOPED LAMINAR ELECTRIC ARC COLUMN
P. W. Schreiber and E. Schreiber Oct. 1966 29 p refs
(ARL-66-0212; AD-648591) CFSTI: HC $3.00/MF $0.65

An analog computer program was developed to help design high power electric arcs as well as to make comparisons between measured and corresponding calculated results based on available transport and thermodynamic data. Information which may be estimated with the help of the computer program includes arc current as a function of electric field strength, temperature distributions, velocity distributions, and radiant power. In addition, any quantity which depends on the above quantities may be estimated. However, the above results may only be applied to the developed region of a cylindrical arc. Author (TAB)

N67-26948# GCA Technology Div., GCA Corp., Bedford, Mass.
THEORETICAL STUDY OF DYNAMIC SHIELD RESPONSE Final Report, 3 Mar. 1965–2 Oct. 1966
E. T. Florance, J. I. F. King, and M. M. Klein Oct. 1966 81 p refs
(Contract AF 19(628)-5095)
(GCA-TR-66-11-A; AFCRL-66-753; AD-648956) CFSTI: HC $3.00/MF $0.65

A review is given of the theory and experimental confirmation of the dynamic shield response, a propagating ionization front generated by intense microwave irradiation of a non-uniform plasma. The original ray theory treatment of electromagnetic energy deposition was generalized to include the effects of reflection. It is shown that the development of a nonlinear response is not substantially affected by including reflection. Electron density profiles for the steadily propagating response are calculated with and without spatial dispersion near the plasma resonance or turning point. To obtain a more accurate model of energy deposition around the turning point, a solution of the Helmholtz equation given by Heading is employed. Profiles are computed by numerical integration of the electron growth equation. A detailed discussion of ionization processes in an rf discharge is presented. The importance of photoprocesses in producing precursor electrons is stressed, and a model of the precursor profile is developed. Finally, areas of possible application are suggested for utilizing the properties of the nonlinear shield response. Author (TAB)

N67-26995# Princeton Univ., N. J. Plasma Physics Lab.
OSCILLATIONS AND DIFFUSION IN A SHEAR STABILIZED Q-MACHINE
Francis F. Chen 15 Feb. 1967 28 p refs Presented at the Intern. Conf. on Phys. of Quiescent Plasmas, Frascati, Italy, Jan. 1967
(Contract AT(30-1)-1238)
(MATT-522; CONF-670104-4) CFSTI: HC $3.00/MF $0.65

Recent theoretical work has indicated the importance to plasma stability and confinement of universal collisionless instabilities, resistive drift modes, collisionless quasimodes, and resistive quasimodes. These instabilities are investigated in a thermally ionized potassium plasma. The effects of magnetic shear on these waves and on diffusion are investigated. NSA

N67-27007# California Univ., Los Angeles. Plasma Physics Group.
PLASMA STREAMING INTO A MAGNETIC FIELD
Sidney L. Ossakow Nov. 1966 65 p refs
(Contract Nonr-4756(01))
(R-10; AD-648083) CFSTI: HC $3.00/MF $0.65

Contents: Non-linear solution for upper hybrid oscillations in a slab geometry; Investigation of instabilities in the slab geometry; The quasi-linear boundary value problem. TAB

N67-27092*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PLASMA PHYSICS
In its Res. Lab. of Electron. 15 Apr. 1967 p 71–134 refs
(See N67-27081 14-23)
(Contracts AT(30-1)-1842; DA-28-043-AMC-02536(E))

Revision of an earlier edition of "Basic Data of Plasma Physics" was completed. The computer system produces a list of cyclic permutations of each reference, successive permutations being with the different words of four or more letters appearing in the reference. After forming permutations of all entries, the computer alphabetizes them according to the key word. Experimental results are also given for far infrared plasma diagnostics. Other topics briefly reviewed are: electron density measurements with a narrow-band far infrared interferometer; microwave scattering from warm plasma waves near the electron cyclotron frequency; nonlinear harmonic generation at plasma resonance; laser breakdown experiment; and microwave emission from n-type indium antimonide. R.U.

N67-27093*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
GASEOUS ELECTRONICS
In its Res. Lab. of Electron. 15 Apr. 1967 p 135–140 refs
(See N67-27081 14-23)
(Contract DA-28-043-AMC-02536(E))

The Boltzmann collision integral accounts for the effect of electron–atom collisions on the propagation of waves and plasma, and it is utilized to calculate the form of the dispersion relation for the electron plasma wave in the presence of electron–atom collisions. Advantages are briefly listed for the Krook model which accounts for collisions when studying collisional effects on the electron plasma wave. The other method described is considered too cumbersome to apply to plasmas with high electron temperatures, but it does account exactly for the collisional effects. The results of both methods are compared. R.U.

N67-27094*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PLASMAS AND CONTROLLED NUCLEAR FUSION
In its Res. Lab. of Electron. 15 Apr. 1967 p 141–216 refs
(See N67-27081 14-23)
(Grants NSF GK-47; NSF GK-1165)

Technological advancements are reported on plasmas and controlled nuclear fusion in active plasma systems, applied plasma physics, and plasma magnetohydrodynamic flows. Some problems discussed briefly in plasma systems are: excitation of an ion-cyclotron resonance; beam-plasma discharge; cross-field beam-plasma experiments; experimental investigation of beam-plasma interaction; anomalous millimeter microwave plasma density measurements; theory of beam-plasma interactions; dispersion relations for beam-plasma interactions; sheet models of the beam-plasma discharge; effect of essential singularities in stability criteria; and motion of charged particles in magnetic mirror field in the presence of a radial time-variant electric field. In relation to controlled nuclear fusion, an experimental study of hollow-cathode discharge arc plasma is described. Technical details are also given on magnetohydrodynamic wave propagation transverse to magnetic field. R.U.

N67-27096*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
SPONTANEOUS RADIOFREQUENCY EMISSION FROM HOT-ELECTRON PLASMAS
In its Res. Lab. of Electron. 15 Apr. 1967 p 219–221 ref
(See N67-27081 14-23)
(Contract AT(30-1)-3581)

The instability occurring in the afterglow of a pulsed electron-cyclotron resonance discharge is briefly reviewed. Above a background pressure of approximately 2×10^{-5} Torr H_2, the plasma was observed to be stable. Figures show afterglow behavior of the pulsed electron-cyclotron discharge under repeatable operating conditions, as well as typical behavior under nonrepeatable operating conditions. The behavior of the bursts, and the microwave radiation effect on stored energy is still not understood, and continued investigation on the intense instability is recommended. R.U.

N67-27097*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
INTERACTION OF LASER RADIATION WITH PLASMAS AND NONADIABATIC MOTION OF PARTICLES IN MAGNETIC FIELDS
In its Res. Lab. of Electron. 15 Apr. 1967 p 223–229 refs
(See N67-27081 14-23)
(Contract AT(30-1)-3285)

Summarized technical progress is reported on incoherent scattering of light from a Plasma IV, and electron diffusion in a helically perturbed magnetic field of stellarator. The interaction of laser radiation with plasmas and nonadiabatic motion of particles in magnetic fields is stressed. R.Li.

N67-27244# Princeton Univ., N. J. Plasma Physics Lab.
WEAK TURBULENCE IN A HOMOGENEOUS PLASMA
Ronald C. Davidson Nov. 1966 140 p refs
(Contract AT(30-1)-1238)
(MATT-496) CFSTI: HC $3.00/MF $0.65

The problem of weak plasma turbulence is considered within the framework of the B–B–G–K–Y hierarchy of equations for a fully ionized, magnetic field-free, spatially homogeneous, ensemble of slightly unstable (in velocity space), multispecies, plasmas. The hierarchy equations, utilizing the Bogoliubov–Krylov multiple time-scale technique, are expanded in the small parameter ϵ_q where $1>>\epsilon_q \approx \psi_k/nmv_{av}^2 \approx \gamma_k/\omega_k >> \epsilon_p$. The quantity ψ_k is the wave energy density associated with the unstable modes; nmv_{av}^2 represents the particle kinetic energy density; γ_k is a linear growth rate typical of the unstable modes and, ω_k the associated oscillation frequency. The quantity ϵ_p is the usual plasma parameter ($1/\epsilon_p \approx$ the number of particles in a Debye sphere). In the analysis, which is carried out to order ϵ_q^2, closure of the hierarchy equations is obtained by ordering out the irreducible four-particle correlations. Author (NSA)

N67-27276*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ESTIMATION OF ELECTRON IMPACT EXCITATION CROSS SECTIONS OF MOLECULAR HYDROGEN
George M. Prok, Carl F. Monnin, and Henry J. Hettel Washington, NASA, Jun. 1967 40 p refs
(NASA-TN-D-4004) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Cross sections for ionization and excitation of diatomic molecules by electron impact are calculated using a modification of Gryzinski's semiclassical theory. The theoretical model is described. Specific results are given for molecular hydrogen, initially in the ground electronic state, with electron energies ranging up to 360 electron volts. Transitions to principal quantum levels 2, 3, and 4 in both the singlet and triplet systems are considered, including both direct excitation and exchange since there are competing processes. A total cross section for all states above n=4 is also calculated, as is the ionization cross section. Theoretical direct excitation and exchange cross sections were compared qualitatively with available line intensity data. Good agreement was found both in the shape of the curve and in the location of the peak. The results are compared with experimental ionization data as well as with results based on the Born approximation. In addition, some results for the nitrogen molecule are presented. The results indicate that the molecular model presented in this report gives acceptable estimates of cross sections for excitation of ground-state molecular hydrogen. Author

N67-27303*# Naval Ordnance Lab., White Oak, Md.
OPACITY OF HOT, HIGHLY COMPRESSED HYDROGEN Final Report
G. T. Lalos and G. L. Hammond 16 Nov. 1966 52 p refs
(NASA Order C-80708)
(NASA-CR-72116; NOLTR-66-202) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The rapid gas compression technique employing a ballistic piston compressor was adapted to the study of the opacity of hydrogen at elevated pressures and temperatures. Hydrogen/helium mixtures were compressed for short times to pressures and temperatures exceeding 2500 atmospheres and 5000°K, and the emission spectra were recorded and analyzed. The discrete line spectra were identified as due to metallic impurities, but the strong background continua could not be ascribed unequivocally to hydrogen. Computer calculations of the specie concentrations that comprise hot, highly compressed hydrogen/helium mixtures were made, and possible opacity producing mechanisms were advanced to explain the observed continua. Author

N67-27362*# Avco-Everett Research Lab., Everett, Mass.
[PLASMA RADIATION SHIELDING] Quarterly Progress Report, 24 Dec. 1966–23 Mar. 1967
(Contract NAS8-20310)
(NASA-CR-84403) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The motions of thin and thick low density ($q=\omega_p^2/\omega_c^2 << 1$) crossed-field electron beams have been studied on the computer. Theoretical indications that such beams can be stable or unstable depending on the geometrical and electrical arrangements are supported, and the large amplitude behavior of unstable configurations is found. In particular, thick, periodic beams can be quite stable against perturbations of the diocotron type. Author

N67-27368*# Michigan Univ., Ann Arbor.
FREQUENCY MULTIPLICATION IN HIGH-ENERGY ELECTRON BEAMS Semiannual Progress Report, Oct. 1, 1966–Apr. 1, 1967
W. D. Getty, R. J. Lomax, N. A. Masnari, and J. E. Rowe May 1967 9 p refs
(Grant NGR-23-005-183)
(NASA-CR-84409; SAPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Progress is reported in a program to investigate (1) the interaction of high energy electron beams with quasi-optical circuits and plasmas (Cerenkov radiation), (2) electron beam-plasma interactions using cold cathode discharges, (3) nonlinear electron beam-plasma theory, and (4) instabilities in non-Maxwellian plasmas. Emphasis placed on the development of a device for the generation of millimeter wavelength radiation by the use of a tightly bunched relativistic electron beam, and instabilities at cyclotron harmonics in a non-Maxwellian plasma. C.T.C.

N67-27378*# Illinois Univ., Urbana. Antenna Lab.
WAVEGUIDES FILLED WITH MAGNETOPLASMAS OF VARIOUS TYPES
Inci Akkaya May 1967 175 p refs
(Grant NsG-395)
(NASA-CR-84419; Rept.-67-4; SR-10) CFSTI: $3.00 CSCL 20I

Wave propagation in a linearized, homogeneous magnetoplasma of bounded and unbounded regions was investigated in detail. Plasmas of various models are considered in order to evaluate the effects of electron temperature and of the resonances on the waves. In this thesis three models are studied: the usual incompressible model, the compressible fluid model and a microscopic model. The second model is based on the transport equations and the third on the Boltzmann equation with an assumed Maxwellian velocity distribution at equilibrium. Waves in a circular waveguide filled with either incompressible or compressible plasma are analyzed under the boundary condition that the tangential electric field is zero and for the latter case the normal electron velocity is zero on the guide wall. Author

N67-27418*# Holman (John F.) and Co., Inc., Washington, D. C.
MEASUREMENT OF HALL'S CURRENT IN A HOMOPOLAR DEVICE [IZMERENIYE KHOLLOVSKOGO TOKA V GOMOPOLYARNIKE]

E. M. Drobyshevskiy and S. I. Rozov Washington, NASA, Apr. 1967 8 p refs Transl. into ENGLISH from Zh. Tekhn. Fiz. (Leningrad), v. 37, no. 2, 1967 p 322–326
(Contract NASw-1495)
(NASA-TT-F-10874) CFSTI: $3.00 CSCL 20I

The ratio of Hall current density to radial current density was measured in a homopolar device using air, hydrogen, argon, and krypton. It was established that this ratio is independent of gas pressure and decreases slowly as the magnetic field is increased. As a rule the Hall current is slightly greater for the case of positive polarity compared with the case of negative polarity of the internal electrode. Author

N67-27441# Oak Ridge National Lab., Tenn.
ELECTRON-TEMPERATURE VARIATION INDUCED EFFECTS AND LANDAU DAMPING OF ION-ACOUSTIC WAVES
David Montgomery (State Univ. of Iowa), I. Alexeff, and W. D. Jones 1966 28 p refs Presented at the Conf. on Phys. of Quiescent Plasmas, Frascati, Italy
(Contract W-7405-ENG-26)
(ORNL-D-2827; CONF-670104-1) CFSTI: HC$3.00/MF$0.65

Quiescent plasmas were produced in a very simple spherical discharge tube. Ion acoustic waves were propagated in these plasmas. The velocity of the waves was observed as a function of the electron temperature. Both the ion temperature contribution to the wave velocity and the onset of Landau damping as the electron temperature is reduced were observed. As a second demonstration of the Landau damping, a light contaminant was added to the plasma and damping was observed without changing the bulk properties of the plasma. As a by-product of this study, a simple device was developed for producing a quiescent plasma in which the electron temperature can be varied over a very wide range. NSA

N67-27445# United Aircraft Corp., East Hartford, Conn. Research Labs.
PRODUCTION OF PLASMAS FOR THERMONUCLEAR RESEARCH BY LASER BEAM IRRADIATION OF SOLID PARTICLES Semiannual Report, 29 Jun.–31 Dec. 1966
Alan F. Haught and Donald H. Polk 31 Jan. 1967 31 p
(Contract AT(30-1)-2578)
(NYO-3578-5; UARL-E-920365-5) CFSTI: HC $3.00/MF $0.65

An experimental and theoretical investigation was made of the production of plasmas for thermonuclear research by laser beam irradiation of a small solid particle. For these studies the focused high intensity beam from a Q-spoiled laser is used to form a high-temperature, high-density plasma from a single solid particle of lithium hydride 10 to 20 μ in diameter which is electrically suspended in a vacuum environment free of all material supports. Both detailed hydrodynamic calculations and a simplified integrated similarity model of the plasma generation and growth have been developed. These models, which include the effects of laser pulse time history, fraction of the incident beam absorbed by the expanding plasma, and radial density and velocity gradients within the plasma, give results for the plasma radial density distribution, velocity profile, and plasma energy in good agreement with those determined experimentally. NSA

N67-27446# Royal Inst. of Tech., Stockholm (Sweden).
ELECTRIC FIELD PARALLEL TO THE MAGNETIC FIELD IN A LOW-DENSITY PLASMA
Hans Persson 10 Feb. 1967 20 p refs
(NP-16478)

A collisionless plasma in an inhomogeneous magnetic field was investigated. The principle of quasineutrality and the assumption that the particles move without collisions is shown to imply that in general there is a significant electric field parallel to the magnetic field. Brief applications to the magnetosphere and to a laboratory experiment devoted to a study of the parallel electric field are discussed. NSA

N67-27491# California Univ., Berkeley. Lawrence Radiation Lab.
ATOMIC-DENSITY MEASUREMENTS IN A DECAYING HIGHLY IONIZED HYDROGEN PLASMA
Peter Russell Forman (Ph.D. Thesis) 31 Oct. 1966 77 p refs
(Contract W-7405-ENG-48)
(UCRL-17177) CFSTI: HC$3.00/MF$0.65

Atomic density measurements in a decaying, dense, highly ionized hydrogen plasma have been performed by a vacuum UV-absorption technique. Light of wavelength 890.8 Å is shone through the plasma, and its attenuation, caused by photoionization of the hydrogen atoms present, is measured. The plasma is formed in a copper cylinder 86.4 cm long with a radius of 7.3 cm. In the interior, the initially highly ionized plasma, which has an ion density of 4.9×10^{15} ions/cc and a temperature of about 1 eV, is found to decay by three-body volume recombination. Its atomic density is observed to increase in time at the correct rate, which confirms the earlier notion that this part of the plasma indeed recombines in situ, and remains near Saha equilibrium for up to 200 μsec. During the formation of the plasma, apparently a layer of atoms is formed near the cylinder wall. This layer has been detected and observed to relax in a time consistent with diffusion inward due to charge-exchange collisions with the ions of the plasma. The energy loss in the interior regions of this plasma is observed to be at a rate considerably in excess of that expected from normal thermal conductivity or even from anomalous diffusion of ions. Author (NSA)

N67-27493# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
STUDIES OF IONIZING SHOCK-WAVES IN HYDROGEN Progress Report
J. R. Freeman and W. J. Byatt Dec. 1966 28 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(Rept.-290-743; SC-CR-66-2145; PR-73) CFSTI: HC $3.00/MF $0.65

A continuation of previously reported work in the field of ionizing shock waves in the presence of magnetic fields is presented. In particular, an extension of the model to include a description of the inverse pinch experiments described by Vlases is discussed. The similarity between classical blast wave theory and an inverse pinch device, discussed by Vlases, is shown to be in approximate agreement with the computed results. NSA

N67-27496# Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki.
OPTICAL INTERFEROMETRY OF PLASMA [OITICHESKAYA INTERFEROMETRIYA PLAZMY]
G. G. Dolgov-Savel'ev, E. P. Kruglyakov, V. M. Federov, and V. K. Malinovskii 1966 15 p refs In RUSSIAN
(NP-16554) CFSTI: HC$3.00/MF$0.65

The applicability of optical interferometric methods to the study of plasma is based on the known correlation between the dielectric permeability and the concentration of electrons in the direction of the propagation of the light. If the cross section is known, the mean electron concentration may be obtained. It is also possible to determine the degree of ionization of the plasma by measuring the index of refraction of the neutral gas far from the resonance lines. Quantum generators are usually employed as the light source; in this study, ruby and neodymium glass lasers were used. The lowest electron concentration level that may be detected with an Ach–Zender type interferometer is about 10^{14} cm^{-3} at a plasma length of 10 cm; this sensitivity may be doubled by using a Michelson-type interferometer. NSA

N67-27524*# International Information, Inc., Philadelphia, Pa.
INJECTION OF PLASMA INTO A TRAP WITH OPPOSING MAGNETIC FIELDS [INZHEKTSIYA PLAZMY V MAGNITNUYU LOVUSHKU SO VSTRECHNYMI POLYAMI]
I. M. Zolototrubov, N. M. Ryzhov, I. P. Skoblik, and V. T. Tolok Mar. 1967 5 p refs Transl. into ENGLISH of the book "Fizika Plazmy i Problemy Upravlyayemogo Termoyadernogo Sinteza" Kiev, 1965 p 21–25 Presented at the 4th Conf. on Plasma Phys. and Probl. of Controlled Thermonucl. Fusion, Khar'kov, 20–25 May 1965
(Contract NASw-1499)
(NASA-TT-F-10840) CSCL 20I

This is an experimental investigation of the injection of a plasma from a coaxial plasma gun, operating in the small-delay mode, into a magnetic trap with opposite fields. It is found that after 840 μsec from the beginning of injection, an X radiation of high intensity appears, caused by the deceleration of charged particles exiting from the trap along the magnetic gap. The energy obtained, 3.8 keV, is found to coincide with that of the hydrogen ions in the head of the injected plasma jet. Author

N67-27525*# International Information, Inc., Philadelphia, Pa.
CONICAL MAGNETOGASDYNAMIC FLOW WITH A HALL EFFECT IN AN AXIAL MAGNETIC FIELD [KONUSNOYE MAGNITOGAZODINAMICHESKOYE TECHENIYE S EFFEKTOM KHOLLA V AKSIAL'NOM MAGNITOM POLE]
A. I. Bertinov, D. A. But, and S. A. Gorbatkov Mar. 1967 13 p refs Transl. into ENGLISH from Magnitn. Gidrodinam., Akad. Nauk Latv. SSR (Riga), no. 3, 1966 p 29–38
(Contract NASw-1499)
(NASA-TT-F-10830) CSCL 20I

The article considers conical magnetogasdynamic flow of an ideal, incompressible, electrically conducting gas with Hall effect in an axial magnetic field. The electric power which is drawn from the electrodes is obtained as a consequence of the Faraday and Hall effects. The magnetic Reynold's number is considered to be significantly less than unity. Analytical equations are obtained which enable evaluation of the principal electrodynamic and energy characteristics of the flow. The optimum output power is related to different parameters. It is shown that with respect to the specific electric power the considered flow is lower than the well-known types of MGD flow in a transverse magnetic field. Nevertheless, it requires no insulation of the channel walls, which in turn permits higher limiting temperatures of the working medium, simplifies the construction of the channel and improves the reliability of the device in operation. Author

N67-27532*# International Information, Inc., Philadelphia, Pa.
EFFECT OF THE PROCESS OF IONIZATION ON THE STRUCTURE AND STATE BEHIND A SHOCK WAVE IN A MAGNETIC FIELD [O VLIYANII PROTSESSA IONIZATSII NA STRUKTURU I SOSTOYANIYE ZA UDARNOY VOLNOY V MAGNITNOM POLE]
P. L. Gusika and G. S. Sukhov Mar. 1967 13 p Transl. into ENGLISH from Magnitn. Gidrodinam., Akad. Nauk Latv. SSR (Riga), no. 3, 1966 p 45–54
(Contract NASw-1499)
(NASA-TT-F-10829) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The authors perform a qualitative analysis of the structure of a plane magnetohydrodynamic shock wave, taking into account the process of ionization on the basis of one-dimensional equations in a single-fluid approximation. The results of numerical calculations of the flow parameters behind the shock are compared with data obtained without taking the process of ionization into account. Author

N67-27601*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MICROWAVE DRIVEN MAGNETIC PLASMA ACCELERATOR STUDIES (CYCLOPS) Final Report, 28 Feb. 1966–27 Feb. 1967
G. F. Crimi, A. C. Eckert, and D. B. Miller 24 Mar. 1967 148 p refs
(Contract NAS3-8903)
(NASA-CR-72227) CSCL 20I

CONTENTS:
1. INTRODUCTION 2 p
2. EXPERIMENTAL EQUIPMENT 27 p
3. DIAGNOSTIC INSTRUMENTATION 26 p
4. EXPERIMENTAL RESULTS 53 p
5. SUMMARY AND CONCLUSIONS 6 p refs

APPENDIXES
6. DETECTION OF THE DIAMAGNETIC EFFECT A. C. Ecker and G. F. Crimi 2 p (See N67-27602 14-25)
7. R-F WAVE PROPAGATION IN CYCLOPS G. F. Crimi 8 p (See N67-27603 14-25)
8. LANGMUIR PROBE IN A MAGNETIC FIELD G. F. Crimi 2 p (See N67-27604 14-25)
9. ION ENERGY ANALYSIS G. F. Crimi 2 p (See N67-27605 14-25)
10. RADIATION G. F. Crimi 3 p (See N67-27606 14-25)

N67-27602*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DETECTION OF THE DIAMAGNETIC EFFECT
A. C. Eckert and G. F. Crimi *In its* Microwave Driven Magnetic Plasma Accelerator Studies 24 Mar. 1967 2 p (See N67-27601 14-25)

The case of an electrostatically shielded coil of turns encircling a plasma stream is considered. The net flux through the coil is the flux due to the field coil minus that due to the diamagnetic property of the plasma. If the net flux through the coil changes in time due to the build up or decay of the plasma then an emf will be induced in the coil. The magnetization per unit volume is given, and the magnetic moment is related to the electron transverse energy and the steady state magnetic field. S.P.

N67-27603*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
R-F WAVE PROPAGATION IN CYCLOPS
G. F. Crimi *In its* Microwave Driven Magnetic Plasma Accelerator Studies 24 Mar. 1967 8 p (See N67-27601 14-25)

Several simplifications are applied to the propagation of the rf wave in the cyclops engine. The case of particular small region of electron cyclotron resonance is considered. From a plot of the field strength vs axial distance from the window there is an indication of thermalization over a distance of 1.5 cm after the resonance point. It is concluded that the existing theories for plane waves in Maxwellian magnetoplasmas are applicable in the analysis of wave propagation in the cyclops engine. The main point brought out is that in the resultant dispersion relation the temperature dependence of the wave propagation becomes clear. The resonance shift is explained by the theories which ascribe the damping mechanism of the wave energy to a phase mixing or phase trapping of wave energy particles synchronous with the wave due to their doppler-shifted frequency. An approximation is also given for the penetration depth for a reflecting wave. S.P.

N67-27604*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
LANGMUIR PROBE IN A MAGNETIC FIELD

G. F. Crimi *In its* Microwave Driven Magnetic Plasma Accelerator Studies 24 Mar. 1967 2 p (See N67-27601 14-25)

An analysis from a treatment of cylindrical probe theory in a magnetic field is presented. The case of an electrostatic probe aligned parallel to a magnetic field is considered. The solution of the probe current density in the retarding electron collection region is given. Examination of the cyclotron radii for the plasma species shows that at no time are they much greater than the probe radius. It is concluded that no plausible criterion has yet been established to concisely determine the usefulness of the electrostatic probes in the measurement of plasma density in large magnetic fields. S.P.

N67-27605*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

ION ENERGY ANALYSIS

G. F. Crimi *In its* Microwave Driven Magnetic Plasma Accelerator Studies 24 Mar. 1967 2 p (See N67-27601 14-25)

Results of an ion energy experiment are presented. A four-gridded probe was introduced into the experiment so that the first grid could be biased so secondary electrons due to ion bombardment emitted from the collecting plate could be repelled back to the plate and, therefore, could not be interpreted as an increase in ion current. It was noted, however, that for large positive potentials on screen two a negative (electron) current was measured at the plate. This current became larger when either screen three was biased highly negative or if screen one was biased more than several volts negative. The condition of a false ion current was masked by this unexpected phenomena. The effect of the presence of a plasma generated from neutrals inside the probe was first examined, and it was decided that the intra-probe plasma could not account for the observed phenomenon. further examination revealed secondary emission from the screens could account for the observed effects. High energy ion bombardment of the plate also produced secondary emission. S.P.

N67-27606*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

RADIATION

G. F. Crimi *In its* Microwave Driven Magnetic Plasma Accelerator Studies 24 Mar. 1967 3 p (See N67-27601 14-25)

Several types of particle radiation were considered to determine the energy loss mechanism of the cyclops plasma. Data on multiply ionized particles was limited, and the results were based on data available for argon, the propellant used exclusively in the pulsed experiment. Radiation mechanisms in a high temperature plasma are examined, and the total radiated power is given as the sum of the free–free, free–bound, and bound–bound or line radiation. It is shown that the resonant line radiation is a major loss mechanism. This mechanism plus that of losses in higher ionizations apparently severely limits the usefulness of certain elements as propellants. S.P.

N67-27661*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.

THE CAUCHY-INTEGRAL ROOT-FINDING METHOD AND THE PLASMA LOSS-CONE INSTABILITY

B. D. Fried (Calif. Univ., Los Angeles) and J. E. McCune Jan. 1967 50 p refs

(Grant NsG-496; Contracts Nonr-4765(01); ARPA SD-265; Grant NSF G-4454)

(NASA-CR-84501; CSR-TR-67-1) CFSTI: $3.00 CSCL 20I

The numerical solution of the dispersion relation for a magnetized collisionless plasma in the case of the "loss-cone instability" is described. The solution is based on the use of certain Cauchy integral theorems, combined with the use of graphical display techniques. The numerical results and graphical display information were obtained with the use of the Culler on-line computer system. Only a very limited range of the relevant parameters occurring in the plasma disperions relation is studied. Attention is focused on establishing the properties of the unstable modes during transition from the Harris-(single-resonance)-type instability to the multiple-resonance type of Rosenbluth and Post for very short wave lengths. A secondary aim is to provide a further illustration of the utility of the Cauchy-integral root-finding technique. Author

N67-27709*# Avco-Everett Research Lab., Everett, Mass.

THE PLASMA RADIATION SHIELD: CONCEPT, AND APPLICATIONS TO SPACE VEHICLES

Richard H. Levy and Francis W. French Apr. 1967 96 p refs Submitted for publication

(Contract NAS8-20310)

(NASA-CR-84420; Avco-Everett Res. Rept.-258) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The plasma radiation shield is an active device using free electrons, electric and magnetic fields for the purpose of shielding astronauts from energetic solar flare-produced protons. The concept of plasma radiation shielding is reviewed in the light of current studies. The available evidence indicates that the concept is physically sound, but important practical questions remain in at least two areas: these have to do with establishment and control of the extremely high voltages required, and with integration of the concept into a realistic vehicle design. Author

N67-27726# Boeing Scientific Research Labs., Seattle, Wash.

PLASMA PHYSICS LABORATORY REVIEW

[1966] 24 p refs

Research activities at the Plasma Physics Laboratory are briefly reviewed. They include research in the areas of plasmas in solids, a laser interferometer earth strainmeter, plasma diffusion, laser production of plasmas, perturbations of cavities by lossy plasma spheres, resonant particle energy transfer to magnetic perturbations with application to the geomagnetic tail, plasma radiation from metal foils, quantum theory of plasma oscillations in a thin metal film, the generation of random numbers and the statistical nature of quantum processes, collisional plasma heating, high frequency field penetration, optical radio frequency interactions, and electrical conduction in liquids. R.N.A.

N67-27769# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.

HIGH TEMPERATURE TRANSPORT PROPERTIES OF ARGON PLASMAS

K. Gopalakrishna Mar. 1967 99 p refs

(Grant NSF GK-65)

(TR-29) CFSTI: HC $3.00/MF $0.65

The transport properties: 1) electrical conductivity, 2) radiation source strength, 3) thermal conductivity, and 4) viscosity of argon plasmas were deduced from arc data (current, voltage, radiation, pressure drop, and temperature distribution). The first three properties were calculated by inverting the energy equation. All the deduced properties, except for the thermal conductivity in the temperature range of 12,000°K to 13,750°K, agree reasonably well with the kinetic and radiation theories. The exact reason for this discrepancy is not known. L.S.

N67-27771# Boeing Scientific Research Labs., Seattle, Wash.

PERTURBATION OF MICROWAVE CAVITIES BY LOSSY DIELECTRICS AND PLASMAS

Richard B. Hall Feb. 1967 43 p refs

(D1-82-0602) CFSTI: HC $3.00/MF $0.65

The frequency shift and Q change of a microwave cavity caused by lossy dielectrics or plasma spheres or cylinders is calculated. The necessity for this analysis is prompted by the use of microwave cavities to measure the expansion of nearly spherical

plasmas created by focused high power lasers. The conditions required for the perturbing volume to behave as if it were a perfect conductor are examined. It is found that much lower conductivities (or permittivities) are required when the perturbing volume is placed in a cavity region where electric energy is predominant. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N67-26484 Royal Radar Establishment, Malvern (England).
THE ACTION OF 0.2–8 mm ELECTROMAGNETIC RADIATION ON THE CONDUCTIVITY OF n–InSb AT HELIUM TEMPERATURES
A. N. Vystavkin, V. N. Gubankov, and V. N. Listvin May 1966 13 p refs Transl. into ENGLISH from Acad. Sci. USSR, Solid State Phys. (USSR), v. 8, no. 2 p 443–447
(RRE-TRANS-149)

The electrical and SHF properties in the spectral range 0.2–8 mm of a series of n–InSb samples are investigated at helium temperatures. From the results, conclusions are made concerning the predominance of the thermoconcentration (carrier heating–translator) mechanism of the action of the radiation on the conductivity of n–InSb at helium temperatures. Author

N67-26502*# Kansas Univ., Lawrence.
INVESTIGATION OF ELECTROCALORIC EFFECTS IN FERROELECTRIC SUBSTANCES Status Report, Sep. 1, 1966–Feb. 28, 1967
28 Feb. 1967 23 p refs
(Grant NsG-575)
(NASA-CR-84162; SR-6) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Measurements of electrocaloric effects were made on single crystals of tartaric acid. The method of obtaining the spontaneous polarization, $P_s(T)$, by means of thermal depolarization currents was validated by trials with previously measured triglycine sulfate. Then the thermal depolarization method was used to obtain $P_s(T)$ of tartaric acid, a substance for which conventional methods for measuring $P_s(T)$ are not feasible. The pyroelectric coefficient of tartaric acid from 104°K to 330°K was computed from the values of $P_s(T)$ so obtained. Experiments revealed that vacuum plated metal electrodes give higher values of polarization than do measurements with metal foil or silver paste electrodes, 3% to 10% higher for triglycine sulfate at 60 cps. Author

N67-26570*# National Aeronautics and Space Administration, Washington, D. C.
ELECTRON THEORY OF METALS, BASED ON FERMI STATISTICS. PART I: GENERAL DATA, FLOW PROCESSES, AND WORK FUNCTIONS [ZUR ELEKTRONENTHEORIE DER METALLE AUF GRUND DER FERMISCHEN STATISTIK. I. TEIL: ALLGEMEINES, STROEMUNGS-UND AUSTRITTS-VORGAENGE]
A. Sommerfeld May 1967 34 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 47, 1928, p 1–32
(NASA-TT-F-10871) CFSTI: $3.00 CSCL 20L

The electron theory of metals, specifically flow processes and work functions, are discussed on the basis of Fermi statistics and Bose–Einstein statistics, with a comparison of classical statistics. The basic difference between quantum statistics and classical statistics consists primarily in that the mean velocity of the electrons, in first approximation, is independent of the temperature and that the corresponding de Broglie wavelength mainly depends on the electron density. The hypotheses of the older electron theory on the behavior of metal atoms and their interaction with electrons are recalculated with the formulas of quantum statistics. Thermal conductivity, thermoelectric, galvanomagnetic, and thermomagnetic effects are discussed briefly. Author

N67-26609# Illinois Univ., Urbana. Coll. of Engineering.
MINING, METALLURGY, AND PETROLEUM ENGINEERING
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 133–146 refs
(See N67-26601 14-34)

Metallurgical engineering technological advancements are reported briefly on the following areas: stress effect on solid state transformations, alloy chemistry of transition elements, application of magnetic meesuring techniques to defect studies, dislocation pipe diffusion, metallurgical studies of fatigue damage in maraging steel, corrosion control of structural steels with anodic inhibition, refractory metals, and nuclear magnetic resonance. Summary details are also included on mining and petroleum engineering studies in geophysics, oceanography, exploration, petrofabrics, and deformation of solids. R.Ll.

N67-26619*# Columbia Univ., New York. Columbia Radiation Lab.
SOLID STATE PHYSICS
In its Res. Invest. Directed Toward Extending the Useful Range of the Electromagnetic Spectrum 31 Oct. 1966 p 76–92 refs
(See N67-26616 14-29)
(Grants DA-ARO(D)-31-124-G568; DA-ARO(D)-31-124-G870; NSF GP-3379; NSF GP-6312)

Columbia University research in solid state physics is reported in the following areas: interaction between a neutral beam and a conducting surface, adiabatic demagnetization in the rotating frame, nuclear magnetic resonance in fine particles, nuclear double resonance in $KClO_3$, photo-echo resonance, and Brillouin scattering. R.Ll.

N67-26622*# Holman (John F.) and Co., Inc., Washington, D. C.
PHYSICAL IDEAS OF THE METHOD OF ELEMENTARY EXCITATIONS (THE MANY-ELECTRON PROBLEM IN THE THEORY OF THE SOLID STATE) [FIZICHESKIYE IDEI METODA ELEMENTARNYKH VOZBUZHDENIY]
V. L. Bonch-Bruyevich Washington, D. C., NASA, Apr. 1967 22 p refs Transl. into ENGLISH from Usp. Fiz. Nauk (Moscow), v. 56, no. 1, 1955 p 55–78
(Contract NASw-1495)
(NASA-TT-F-10870) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The application of the many-electron theory of solids involving the behavior of a large number of interacting particles is proposed for the clarification of certain paradoxes and the solution of new problems in the theory of metals which the single electron is incapable of handling. The solution of the formulated problem is associated with severe difficulties due to complexity of the wave equation for the system of many ($\approx 10^{23}$) interacting particles and due to the necessity of computing complex statistical sums. The problem can be simplified substantially by considering only the weakly excited state of the system. The hypothesis of elementary excitation is examined in the light of recent developments in solid-state physics to show its physical implications and its scope of application in the solution of new problems associated with the solid state. Author

N67-26659# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
PHOTOELECTRON EMISSION IN THE EXTREME ULTRAVIOLET REGION Summary Scientific Report, 6 Sep. 1962–30 Jun. 1966

L. Heroux, H. E. Hinteregger, D. E. Bedo, W. J. McMahon, M. Cohen et al Oct. 1966 86 p refs *Its* Phys. Sci. Res. Papers, No. 280
(ARPA Order 213)
(AFCRL-66-718; AD-648918) CFSTI: HC $3.00/MF $0.65

Photoelectron emission from solid tungsten, nickel, and semitransparent aluminum cathodes exposed to ultraviolet radiation between 256 A and 1216 A has been studied with planar retarding-potential analyzers. The resulting current-voltage diagrams (CVDs) for these three metal cathodes are essentially identical. The CVDs comparing photoelectron emission from the front and rear surfaces of the semitransparent aluminum cathode are also identical. A retarding-potential analyzer having near-spherical geometry was also used to obtain CVDs for the photoelectrons emitted from the rear surface of a thin-aluminum cathode. The value of retarding potential detectors for limited spectral resolution in the extreme ultraviolet is discussed. A comparison of the CVDs for the thin aluminum cathode indicates that the spectral discrimination achieved with a spherical retarding-potential analyzer is superior to that obtained with a planar one. Both the planar and spherical detectors consisted of a retarding-potential analyzer coupled to an electron multiplier. The CVDs obtained by using the multiplier either as a photoelectron counter or in dc operation were found to be identical. The photoelectric yields of several metal and alkali halide cathodes commonly used in the extreme ultraviolet were also compared. Those of CsI and LiF were found to depend upon cathode thickness and to be sensitive to the time of aging in air. Preliminary data on the absolute yield of tungsten between 31.6 A and 304 A are presented. Author (TAB)

N67-26666# California Univ., Los Angeles. Dept. of Physics.
SUPEREXCHANGE INTERACTION BETWEEN MAGNETIC ION PAIRS AND SUPER TRANSFERRED HYPERFINE INTERACTION IN WEAKLY COVALENT CRYSTALS
Dec. 1966 178 p refs
(Contract Nonr-233(88))
(AD-647956) CFSTI: HC $3.00/MF $0.65

The Dirac-Van Vleck-Serbers method of configuration interaction is extended and systematized in order to handle the interaction between transition metal ions. Specific applications are made to the following problems: (i) Exchange interaction between nearest V(2+) neighbors in KMgF3 (collinear superexchange); (ii) Exchange interaction between nearest V(2+) neighbors in MgO (right angle superexchange); (iii) Superexchange interaction between next nearest V(2+) and Ni(2+) neighbors in MgO (exchange between inequivalent ions). The change in hyperfine field at a magnetic cation site due to cation - cation interaction is also calculated. TAB

N67-26701# Emmanuel Coll., Boston, Mass. Oriental Science Library.
THEORY OF TUNNELLING PROCESSES IN GERMANIUM TUNNEL DIODES. (I)—IMPURITY-INDUCED CURRENT. (II)—PHONON-ASSISTED CURRENT
Tze-Chao Kan Bedford, Mass., AFCRL Oct. 1966 82 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 19, no. 1, 1963 p 25–59
(Contract AF 19(628)-5073)
(EMM-65-10; AD-648155) CFSTI: HC $3.00/MF $0.65

Part I deals with a theoretical analysis of the tunnelling current in germanium caused by impurity scattering. It is shown that for a high doping level approximately 10 to the 19th power/cu cm the impurity-induced tunnelling current is important, being comparable with or even stronger than the phonon-assisted tunnelling current. Different impurities act differently; As or P induces a stronger current than Sb. It is argued that the impurity-induced tunnelling current in germanium is dominated by a second order process. An electron tunnelling from the bottom of the conduction band into the forbidden band is first scattered by the impurities into states corresponding to the (0, 0, 0) conduction band minimum, and proceeds thereon to the valence band by virtue of the junction field. A theory is proposed for such a process and a formula for the impurity-induced tunnelling current is derived. Part II deals with a theoretical analysis of the tunnelling current in Ge induced by phonon scattering. It is pointed out that this process should be primarily, a second order one: an electron tunnelling into the forbidden band from the bottom of the conduction band is first scattered by phonons into the states of the (0, 0, 0) conduction band minimum, and then makes a transition to the valence band by virtue of the junction field. It is found that the major contribution to this process is made by the lattice vibrations in a certain range (about 20A in thickness) of the junction field. The transition probability is almost directionally independent. TAB

N67-26873# Rensselaer Polytechnic Inst., Troy, N. Y.
SEEBECK COEFFICIENT OF SEMICONDUCTING OXIDE GLASSES
T. Allersma and J. D. Mackenzie Dec. 1966 17 p refs
(Contract Nonr-591(21))
(TR-4; AD-648333) CFSTI: HC $3.00/MF $0.65

The Seebeck Coefficient, alpha, of semiconducting glasses based on vanadium pentoxide can be calculated from a knowledge of the concentration ratio of the high and low valence ions. The concentration of vanadium ions in the glass and long range order apparently have no effect on alpha. Semiconducting glasses based on iron oxide, however, are not amenable to the simple treatment presently developed. Author (TAB)

N67-26885# Pennsylvania Univ., Philadelphia. Physics Dept.
INFRARED LATTICE VIBRATIONS OF SINGLE CRYSTAL LITHIUM HYDRIDE AND SOME OF ITS ISOTOPIC DERIVATIVES
M. H. Brodsky (Ph.D. Thesis) and E. Burnstein Feb. 1967 41 p refs
(Contract Nonr-551(51))
(TR-9; AD-648461) CFSTI: HC $3.00/MF $0.65

The infrared reflection spectra of single crystal lithium hydride, lithium deuteride, lithium-6 hydride, and lithium-7 hydride have been measured and analyzed. The long wavelength limits of the optical lattice vibrational frequencies have been determined and used to find the static dielectric constants and Szigeti effective charges of all the isotopic variations studied. It is found that the square of the longitudinal (or transverse) frequency is inversely proportional to the reduced mass of the ion pairs forming the crystal. The Szigeti effective charge for LiH, e sub s(*) = (0.53 plus or minus 0.02) e, is qualitatively accounted for by the Dick and Overhauser shell model for the vibrating ions. A slight isotope effect on the e sub s (*) is noted in LiD and the difference in effective charges is interpretable within the framework of the shell model. Author (TAB)

N67-26960# Systems Research Labs., Inc., Dayton, Ohio.
THE ELECTRICAL CONDUCTIVITY OF CERAMICS; ITS MEASUREMENT AND INTERPRETATION
Robert W. Vest Wright-Patterson AFB, Ohio, ARL Dec. 1966 77 p refs
(Contract AF 33(615)-2765)
(SRL-TR-580-B; ARL-67-0010; AD-648958) CFSTI: HC $3.00/MF $0.65

When an oxide ceramic is placed in an electric field and a current flows in the external circuit, there are three primary questions which must be answered in order to understand and utilize this phenomena. These are (1) what are the charge carriers, (2) what factors govern their concentration, and (3) what factors govern their motion. Experimental techniques which provide answers to these questions are discussed with emphasis on problem areas of particular interest for measurements on ceramics. These problem areas include choice of electrodes, selection of measurement

frequency, situ measurements of high impedance samples, effect of sample porosity, and the need for controlled temperature and oxygen partial pressure. Some typical results are presented and discussed in terms of several point defect models. Complementary measurements which, when combined with electrical conductivity, will yield charge carrier mobilities also are discussed. Author (TAB)

N67-26985# Systems Research Labs., Inc., Dayton, Ohio.
THE ELECTRICAL BEHAVIOR OF REFRACTORY OXIDES IV
R. W. Vest and W. C. Tripp Wright-Patterson AFB, Ohio, ARL, Nov. 1966 80 p refs
(Contract AF 33(615)-2765)
(SRL-580-A; ARL-66-0220; AD-648869) CFSTI: HC $3.00/MF $0.65

The research was directed toward a more fundamental understanding of charge and mass transport mechanisms in refractory metal oxides. Special research apparatus and instrumentation was developed in order to carry out the experimental program. The results of a study of the defect structure of Y2 O3 and HfO2 are reported. Measurable weight changes were observed in HfO2 enabling an estimate of the mobility and the energy of motion, as well as the concentration of the defect, to be made. Some thermoluminescence results obtained on Y2 O3 single crystals are reported. A procedure is described for preparing thin foils for transmission electron microscopy which combines the best features of several well known techniques. Author (TAB)

N67-26978# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE INTENSITY OF THE ABSORPTION BANDS OF RUBY
Hsi-Yi Huang 5 Dec. 1966 26 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 20, no. 3, 1964 p 241–251
(FTD-HT-66-498; TT-67-61324; AD-648884) CFSTI: HC $3.00/MF $0.65

In ruby a Cr3+ ion and its six nearest neighboring O2- ions form a heavily distorted ocetahedron. Consequently, the magnitude of odd crystal field of the higher order is comparable with the first order odd field. Because of the site group of Cr3+ ion in ruby approximately retains C3nu symmetry, the higher order crystal field component T2mu type is very small and can be neglected, but those of the T1nu and A2nu type must be taken into account. The higher-order odd field components make appreciable contribution to Y band and U perpendicular band, but their contribution to U parallel band is neglibible. The intensities of U band and Y band are discussed with proper attention paid to the odd vibrations of ions. It has been concluded that the U parallel band absorption is mainly produced through the coupling of odd vibrations with electrons. With this point of view, the oscillator strength, the dichroism, the band shape, etc., of the absorption bands of ruby are analyzed. The results are in good agreement with experimental data. TAB

N67-26980# Illinois Univ., Urbana. Dept. of Electrical Engineering.
JUNCTION EFFECTS IN COMPOUND SEMICONDUCTORS
N. Holonyak, Jr., M. D. Sirkis, G. D. Clark, M. R. Johnson, J. S. Moore et al Dec. 1966 20 p refs
(Contract AF 19(682)-4337)
(SR-7; AFCRL-67-0056; AD-648588) CFSTI: HC $3.00/MF $0.65

The effect of the considerable depth of donor impurity states near the indirect <100> conduction band minima on the direct-indirect transition in Ga(AsP) is discussed. A simple technique for using a Ga(AsP) laser to operate a CdSe or Cd(SeS) laser is described. Ultra-thin CdSe lasers of variable mode spacing, including the special case of single-mode operation, are described. Current oscillations in Au-compensated Si p-i-n diodes were studied. These oscillations are essentially independent of the external circuit (i.e., they are not negative resistance oscillations) and are not attributable to transit time effects. The various parameters affecting these oscillations were examined, and a space-charge instability model which is in accord with the experimental data is proposed. Author (TAB)

N67-27009# Colorado State Univ., Fort Collins.
PLASMA OSCILLATIONS IN SILVER FILM Semiannual and Final Report, Feb. 16–Aug. 15, 1966
Lawrence N. Hadley 15 Aug. 1966 5 p ref
(Contract DA-44-009-ENG-3828)
(SAR-14; FR-14; AD-648429) CFSTI: HC $3.00/MF $0.65

The investigation was concerned with the optical excitation of plasma radiation in a metal film and the detection of this radiation. The experiment was unsuccessful -- that is, with the available sources and detection equipment no radiation was observed in silver films of approximate thickness 300A, deposited on quartz and lithium fluoride substrates. While no radiation has as yet been detected, an indication of plasma oscillation has been observed in an absorption experiment. The absorption experiment made use of the Beckman DK-2A spectroreflectometer. The transmission of silver films of approximately 300A thickness was measured at several angles of incidence in the range 0 - 60 degrees, by inserting the samples on an improvised table just ahead of the integrating sphere. The effect is shown very well in the transmission curves and gives some confidence that with further improvements in the detecting system plasma emission might be seen. TAB

N67-27083*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
MICROWAVE SPECTROSCOPY
In its Res. Lab. of Electron. 15 Apr. 1967 p 5–12 ref (See N67-27081 14-23)
(Contract DA-28-043-AMC-02536(E))

A method of determining an analytical approximation for the velocity of sound surfaces for previously reported crystals was applied to lithium niobate. This method expresses an approximation to each of the three surfaces as a sum over functions of the appropriate symmetries. Graphs represent the surfaces computed exactly and those computed by using analytical approximations. R.Ll.

N67-27088*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
OPTICAL AND INFRARED SPECTROSCOPY
In its Res. Lab. of Electron. 15 Apr. 1967 p 39–47 refs (See N67-27081 14-23)
(Contracts DA-28-043-AMC-02536(E); AF 19(628)-6066)

In relation to optical and infrared spectroscopy studies, reflection measurements on potassium halides in the far infrared region are shown graphically. Dispersion constants are also tabulated from the classical oscillator model. With the use of the Fourier spectrophotometer, several mixed crystals of CdS/Se were studied in transmission at temperatures down to that of liquid helium, and in reflection at temperatures down to that of liquid nitrogen. R.Ll.

N67-27090*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ELECTRODYNAMICS OF MEDIA
In its Res. Lab. of Electron. 15 Apr. 1967 p 51–68 refs (See N67-27081 14-23)
(Grant NsG-330; Contract DA-28-043-AMC-02536(E))

The steps taken to obtain a self-consistent formulation of Maxwell's equations in the presence of a moving quadrupolar medium are summarized. These results are used to develop a simple nonrelativistic model of a fluid consisting of noninteracting

quadrupolar particles (the particles interact solely through the macroscopic fields that they produce). Taking into account interactions among the quadrupolar particles, expressions are generalized for the quadrupolar fluid to a solid. R.Ll.

N67-27172# Pennsylvania Univ., Philadelphia. Dept. of Physics.
THE DYNAMIC IONIC CHARGE ON ZINCBLENDE TYPE CRYSTALS
G. Lucovsky (Xerox Corp.), E. Burstein, and M. H. Bordsky Mar. 1967 16 p refs
(Contract Nonr-551(51))
(TR-10; AD-647970) CFSTI: HC $3.00/MF $0.65

The ionic charges of zincblende type crystals are discussed. Since the static ionic charges are, in general, quite small in these crystals, the magnitudes of the dynamic ionic charge, (e^* sub T), are attributed largely to the effects of charge redistribution. The fairly sizeable values of (e^* sub T) in Se and Te trigonal crystals must, in fact, be attributed entirely to charge redistribution effects since their static ionic charges are identically zero. Efforts to account for the (e^* sub T) values in ZnS type crystals using either the shell model or the deformation dipole model have not been too successful. It is urged that theorists turn their attention to ab-initio energy band calculations of long wavelength dynamical properties of zincblende and diamond type crystals, namely: the first order electric moment (infrared) tensor; the first order electric susceptibility (Raman) tensor; and the change in the electric susceptibility with interatomic distance (piezo-optic) tensor. Author (TAB)

N67-27249# Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
PHYSICAL EFFECTS OF RADIATION IN SOLIDS [EFFETTI FISICI DELLE RADIAZIONE NEI SOLIDI]
F. Pieragostini 1967 15 p refs In ITALIAN Presented at Convegno Sulla Chimica-Fisica Dello Stato Solido e Delle Superfici, Rome, 27 Feb.–1 Mar. 1967
(SORIN-107)

The physical effects of the irradiation of aluminum, and radiation damage in pyrocarbon are reported. This research is intended to study the changes that solids undergo from the effects of radiation, and to contribute to the knowledge of the physical properties of solids. An experimental model was considered to eliminate the damage produced by radiation, and research continued to obtain theoretical and experimental results. Transl. by R.Ll.

N67-27385 Joint Publications Research Service, Washington, D. C.
RATE OF EVAPORATION OF CARBIDE CATHODES OF URANIUM, ZIRCONIUM AND SOLID SOLUTIONS INVESTIGATED
B. S. Kul'varskaya 28 Feb. 1967 17 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 21, no. 51 Nov. 1966 p 368–375
(JPRS-40060; TT-67-30707) CFSTI: $3.00

A combination of the Langmuir and Vecker methods was used to study the evaporation rates of carbide thermal cathodes. The rate of evaporation values of cathodes made of ZrC, UC and their solid solutions were obtained. The highest rate of evaporation belongs to UC cathodes, and the lowest, to ZrC cathodes; their solid solutions occupy an intermediate position. The rate of evaporation of carbide cathodes depends on the type of backing material. Author

N67-27425*# North Carolina State Coll., Raleigh. Semiconductor Device Lab.
INFLUENCE OF Co^{60} GAMMA IRRADIATION ON THE BULK AND SURFACE RECOMBINATION RATES IN SILICON
Michael Anthony Littlejohn (Ph.D. Thesis) 1 Mar. 1967 230 p refs
(Grant NSG-588)
(NASA-CR-84446; SDL-6-588-1) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The technique of photoconductive decay in rectangular semiconductor filaments was used to measure the bulk and surface lifetimes and surface recombination velocity of 100 ohm-cm n- and p-type float zone refined silicon doped with phosphorous and boron, respectively. The influence of Co^{60} gamma radiation on these material parameters was investigated, and a more complete mathematical model for surface recombination velocity was formulated. This model includes the effects of recombination in the space charge region near the surface, and it is shown that this effect can have a significant contribution to the total surface recombination velocity. The recombination center which dominates the bulk lifetime in n-type material was found to be different from the one which controls the lifetime in p-type material. Author

N67-27437*# Field Emission Corp., McMinnville, Oreg.
INVESTIGATIONS OF ELECTRON EMISSION CHARACTERISTICS OF LOW WORK FUNCTION SURFACES Final Report, 27 Sep. 1964–28 Sep. 1966
L. W. Swanson, A. E. Bell, L. C. Crouser, and B. E. Evans Nov. 1966 234 p refs
(Contract NASw-1082)
(NASA-CR-84434) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Accomplishments are reported in a program concerned with the phenomena governing the production of low work function surfaces, and the factors affecting the quality and stability of electron emission characteristics. Emphasis was placed upon field emission, with the formation of low work function surfaces accomplished by (1) adsorption of appropriate electropositive adsorbates, and (2) coadsorption of appropriate electropositive and electronegative adsorbates. Various properties of these surfaces were investigated, and include the temperature dependency of the emission and work function, and the various types of energy exchanges accompanying emission. Also investigated were the energy distribution of the field emitted electron, and various aspects of the surface kinetics of adsorbed layers such as binding energy, surface mobility, and effect of external fields. C.T.C

N67-27458# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF THE MAGNETIC CHARACTERISTICS OF FERRITES WITH A VIEW TO THEIR APPLICATION IN A PROTON SYNCHROTRON [ETUDES DES CARACTERISTIQUES MAGNETIQUES DES FERRITES EN VUE DE LEUR APPLICATION DANS UN SYNCHROTRON A PROTONS]
Khanh Cung Nguyen (Ph.D. Thesis—Paris Univ., Orsay, France) Oct. 1966 108 p refs In FRENCH
(CEA-R-3058)

The magnetic characteristics of seven types of ferrites were measured systematically as a function of various physical parameters which affect them in the functioning of an accelerating cavity. These ferrites were chosen from the values of their initial permeability and their quality factor Q_1. From the results obtained it appears that four of the ferrites, as a function of the magnetic polarization variations, obey simpler laws than those of the other three. For a proton synchrotron operating from 15 to 30 MHz one of the ferrites studied, designated by F3, had the best characteristics for utilization in a proton synchrotron. This ferrite in the frequency range studied had constant initial permeability and quality factor. Moreover the variation of its permeability incrementally reversible by a factor of four can be obtained with the aid of a polarization field of the order of 5,000 amp/m. The parameters studied were the frequency, hf induction, the polarization magnetic field, and the temperature. NSA

N67-27477# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
ENERGY LEVELS IN IRON-DOPED SAPPHIRE
Irving Lessin Oct. 1966 42 p refs *Its* Phys. Sci. Res. Paper No. 274
(AFCRL-66-692; AD-648480) CFSTI: HC $3.00/MF $0.65

Energy levels of the ferric ion in a sapphire lattice are machine-calculated as a function of applied magnetic field and polar and azimuthal angles. The levels are derived for a spin 5/2 system, wherein the Spin Hamiltonian contains one coordinate system pertaining to the cubic system and another for a trigonal system. Use is made of the rotation matrix and a set of functions belonging to an irreducible tensor operator of rank L = 4 to transform the cubic part of the Spin Hamiltonian operator into the trigonal frame of reference, and matrix elements are then calculated. As a check, the matrix elements of the cubic operator are first calculated in the cubic system, and then transformed into the trigonal system. In this connection, a table of the matrix elements of the rotation operator d(5/2) (Beta) is presented, as well as some of the matrix elements of d(4) (Beta) used in the first approach.
Author (TAB)

N67-27487# Brookhaven National Lab., Upton, N. Y.
MOESSBAUER EFFECT IN RUTHENIUM-99
O. C. Kistner 27 Jan. 1967 28 p refs Presented at the 3d Ann. Moessbauer Symp., New York
(Contract AT(30-2)-GEN-16)
(BNL-11026; CONF-670110-1) CFSTI: HC $3.00/MF $0.65

The methodology of studying Moessbauer effect in ^{99}Ru is discussed and illustrated with various magnetic hyperfine spectra. Special attention is given to the uses of ^{99}Ru as a sensitive probe for measuring internal magnetic fields and for testing time reversal invariance. A new type of versatile Moessbauer spectrometer is described.
NSA

N67-27662*# Stanford Univ., Calif. Microwave Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF COLLECTIVE MICROWAVE PHENOMENA IN SOLIDS Semiannual Status Report, 1 Oct. 1966–31 Mar. 1967
M. Chodorow May 1967 29 p refs
(Grant NGR-05-020-165)
(NASA-CR-84502; Rept.-1546; SASR-2) CFSTI: $3.00 CSCL 20L

The rf efficiency of a Gunn diode placed in series with a load resistance shunted by a shorted transmission line, one quarter wavelength long at half the domain transit frequency, is investigated. This simple configuration is capable, for the diodes used, of 16.7% theoretical efficiency. Experimentally measured efficiencies of 15% at around 100 MHz are reported. A possible two port unilateral microwave amplifier using the transferred electron effect in high resistivity GaAs is briefly described. Initial measurements on the static and rf voltage distributions along specimens having the appropriate geometry and made from suitable high resistivity material are reported. The work continued on CdS samples as amplifiers. The amplification properties of GaAs were studied in the frequency range from 1000 to 2000 Mc. The effects of trapping are clearly evident. An optical beam was continuously deflected through an angle of 4° by tuning an acoustic wave in a birefringent crystal of sapphire from 1.28 to 1.83 Gc. The method is based on the change in polarization of the deflected light as compared to the incident light.
Author

N67-27705*# Illinois Univ., Urbana. Dept. of Physics.
AN EXPERIMENTAL INVESTIGATION OF RADIATION EFFECTS IN SEMICONDUCTORS Semiannual Status Report, Jul. 1–Dec. 31, 1963
W. Dale Compton 31 Dec. 1963 18 p refs
(Grant NsG-228-62)
(NASA-CR-84426) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Defect production mechanisms and the microscopic nature of these defects are being studied in a program concerned with the effects of radiation upon the properties of semiconductors. Changes in the bulk properties of germanium and silicon were investigated as a function of the type of irradiation and of the total radiation dose. Studies of the changes in the minority carrier lifetime of irradiated silicon, the recombination luminescence of germanium and silicon, and the influence of irradiation upon the impurity conductivity of germanium are reported. A brief description of the techniques involved and the present status of the studies are included.
C.T.C.

N67-27757# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.
SOLID STATE PHYSICS LABORATORY REVIEW, JULY–DECEMBER 1966
[1967] 34 p refs

Continuing research in the field of solid state physics is reviewed. Some of the topics reported on are stress corrosion cracking of titanium alloys, adsorption of hydrogen on nickel and nickel–copper alloys, nucleation of precipitates from supersaturated aluminum alloys, planar defects in non-stoichiometric compounds, applicability of spectroscopic parameters to bonds in solids, and dosimetry at high radiation doses. It is pointed out that electrochemical research on the stress corrosion of titanium alloys resulted in important findings on the influence of notches, corrosive environment, and electric potential on the strength of alloys. A simple, accurate, and nondestructive method of finding the internal stresses throughout the thickness of windshield glass was also discovered.
L.E.W.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N67-28546*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ORBITAL INVESTIGATION OF PROPELLANT DYNAMICS IN A LARGE ROCKET BOOSTER
H. J. Buchanan and F. M. Bugg Washington, NASA. May 1967 21 p refs
(NASA-TN-D-3988) CFSTI: HC $3.00/MF $0.65 CSCL 21I

Experimental data on the dynamics of liquid hydrogen in the 6.6 m (260 in.) diameter tank of an S-IVB stage during boost, at S-IVB stage cutoff, and in orbit are presented. For the boost phase of flight, the amplitude of the sloshing liquid decreased from approximately 0.25 m at the beginning of S-IVB stage boost to a minimum of about 0.038 m as the liquid level moved past the baffle. The frequency during the S-IVB stage engine burn increased from approximately 0.44 to 0.70 Hz and showed good agreement with predicted values. During orbital coast, periods of the liquid hydrogen oscillation were measured through a range of accelerations from $2.0\times10^{-5}g_o$ to $4.4\times10^{-4}g_o$. Period data taken while the acceleration was varying with time did not agree with either the predicted natural or coupled periods. Nearly steady-state conditions existed for the $8.0\times10^{-5}g_o$ acceleration, and the 300 to 330 second slosh periods measured at this acceleration were close to the predicted value of 315 seconds. The good agreement between experiment and high-g theory at this very low acceleration tends to verify the validity of Bond number as a criterion for defining high-g conditions with regard to liquid sloshing.
Author

N67-26897# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
CALCULATION OF PROPELLANT PERFORMANCE
A. I. Schidlovsky 19 Jan. 1967 46 p refs Transl. into ENGLISH from Entropie (France), no. 9, May–Jun. 1966 p 17–30
(Contract NOw-62-0604-c)
(TG-230-T511; AD-648356)

The article describes the method used by ONERA for calculating the theoretical performance of propellants; it was tested on a large number of propellants. The method was programmed on FORTRAN II for an IBM 704 computer and allows the processing of data relating to substances containing a maximum of 20 elements and capable of giving a total of 250 chemical species in gaseous phase and 20 condensed phases as combustion products. Study of the flow of a gas-particle mixture, with possible changes of the composition in the nozzle, was simplified by assuming that the gaseous phase, which can be considered similar to a theoretically ideal gas, is in thermal and kinetic equilibrium with the condensed particles, the volume of which is negligible as compared with the specific volume of the gas. Once the pressure and temperature have been determined, calculation of the composition in the equilibrium state by the Brinkley method makes it possible to define with these assumptions the thermodynamic state of the system: enthalpy, entropy, specific heat, isentropic expansion coefficient, and sound velocity. General classical equations, applied to a one-dimensional isentropic flow, then permit determination of the state of the system in each section of the nozzle and calculation of the main thrust-related parameters characteristic of rocket engines. Author (TAB)

N67-27130# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fur Raketentreibstoffe.
HYDRAZINE–NITRATE–HYDRAZINE AS A MONERGOLIC PROPELLANT, PART II [DAS SYSTEM HYDAZINNITRAT–HYDRAZIN ALS MONERGOLER TREIBSTOFF, 2. TEIL]
F. Bachmaier Mar. 1967 22 p ref In GERMAN; ENGLISH summary
(DLV-617; DLR-FB-67-22) CFSTI: HC $3.00/MF $0.65

The present report gives information on density and viscosity as a function of temperature, on thermal conductivity and on the thermal decomposition of a solution with 30 weight per cent hydrazine–nitrate in hydrazine. Details of experimental methods and the received results are given as well as advices which are useful for the selection of materials for containers. Author

N67-27224*# National Aeronautics and Space Administration, Washington, D. C.
HIGH ENERGY PROPELLANTS—A CONTINUING BIBLIOGRAPHY WITH INDEXES
Apr. 1967 146 p refs
(NASA-SP-7002(03)) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Presented is a selection of annotated references to unclassified reports and journal articles announced in *Scientific and Technical Aerospace Reports (STAR)*, *International Aerospace Abstracts (IAA)*, and *Aerospace Medicine and Biology* (NASA SP-7011). Emphasis is given to references which are concerned with research and development studies on solid, liquid, and hybrid propellants and oxidizers, but the bibliography also provides extensive coverage of propellant handling and storage, combustion characteristics, toxicity, hazards, and safety measures. Each entry in the bibliography consists of a citation and an abstract. All reports and articles cited were introduced into the NASA Information System during the period January through December, 1966. A subject index and a personal author index are included. Author

N67-27254 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany). Institut fuer Raketentreibstoffe.
RESEARCHES ABOUT THE SYSTEM HYDRAZINE–AMMONIA [UNTERSUCHUNGEN AM SYSTEM HYDRAZIN–AMMONIAK]
Fritz Bachmaier and Jose Jiminez-Barbera Mar. 1967 27 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-21; DVL-616)

Some qualities of hydrazine ammonia mixtures are investigated with regard to their use as rocket fuels. By means of conventional measuring methods being adapted to the problems of these systems, vapor pressures, densities and viscosities of such mixtures are determined as functions of compositions. The findings of these studies show vapor pressure and density deviations from ideal behavior which are a disadvantage, but should not rule out using this system as fuel for rocket engines. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N67-26506*# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
OPTIMUM THRUST NOZZLE CONTOURS FOR CHEMICALLY REACTING GAS FLOWS
Joe D. Hoffman Apr. 1966 107 p refs
(Grant NsG-592)
(NASA-CR-84159; TM-66-3; JPC-424) CFSTI: HC $3.00/MF $0.65 CSCL 21H

An optimization analysis is presented for the design of axisymmetric rocket motor nozzles with chemically reacting gas flows. The problem is formulated to maximize the pressure thrust integral along the supersonic nozzle wall contour for a general isoperimetric constraint. The governing partial differential equations for reacting flows are incorporated into the analysis by means of Lagrange multipliers. The results are a set of partial differential equations for determining the Lagrange multipliers in the region of interest, and a set of algebraic equations for determining initial conditions for these Lagrange multipliers on the boundaries of the region. It is shown that the complete set of equations for the gas dynamic properties and the Lagrange multipliers constitutes a system of first order, quasi-linear, non-homogeneous partial differential equations of the hyperbolic type, which can be treated by the method of characteristics. The characteristic and compatibility equations for the system are presented. A technique for employing the results to determine optimum thrust nozzle contours is presented. Author

N67-26569*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
PERFORMANCE ON THE FW-4 THIRD STAGE MOTOR DELTA 38
T. Stuart 21 Feb. 1967 35 p refs
(NASA-TM-X-55777; X-470-67-117) CFSTI: $3.00 CSCL 21H

The results from the performance instrumentation on the third stage of Delta 38, the first Delta launch vehicle to use the FW-4 as the third stage motor, are presented. The performance instrumentation showed a near-nominal pressure and acceleration record. A telemetry signal shift just prior to third stage ignition, causing a base line shift on the oscillograph records, contributed to a lower than expected total impulse as calculated from the chamber pressure and the thrust-time integral. Specific impulse calculated from orbital reconstruction (283 lbs F-sec/lbsM) was lower than obtained from simulated altitude tests (285 lbsF-sec/lbsM). However, it was comparable with average results obtained from Scout flights (283.7 lbsF-sec/lbsM). No evidence of a pressure disturbance was detected during tailoff and burnout. After burnout the calculated coning half angle of less than one degree was well

below the acceptable level. Measured external FW-4 case temperatures were within the specified maximum tolerance of 500°F for 200° seconds after burnout. Author

N67-26818# Pratt and Whitney Aircraft, East Hartford, Conn.
RESEARCH AND DEVELOPMENT OF TITANIUM ROCKET MOTOR CASE Final Report, Jan. 15, 1964–Jun. 30, 1966
R. J. Makowski and H. A. Hauser Mar. 1967 145 p refs
(Contract DA-19-020-ORD-5230)
(PWA-2894; WAL-766.2/1-21(F); AD-648148) CFSTI: HC $3.00

A program was undertaken to design, fabricate, and test a composite rocket motor case similar to the case used for the first stage of the solid-propellant Pershing missile. The case was to be fabricated from Ti-13V-11Cr-3Al alloy (B-120 VCA) and would consist of two end closures and a center section joined by two circumferential girth welds. The central cylindrical section of the case would be reinforced with circumferentially wound resin-bonded glass filaments. A complete case and an additional reinforced center section were to be fabricated. The case was to be burst tested, and the center section was to be subjected to a buckling stability test. The case was designed, end closures were fabricated, and a satisfactory welding technique was developed. However, it was not possible to develop a satisfactory flow-turning technique for fabricating the center sections from the available number of blanks with the equipment available. Since the primary intent of the program was to evaluate cylindrical sections reinforced with circumferentially wound glass filament, it was decided to reinforce an existing thin-walled titanium cylinder and subject the resulting part to a buckling stability test. The cylinder failed at an axial compressive load of 385,000 pounds, which compares with an analytically determined failure load of 431,000 pounds. The test demonstrated that the level of prestress produced in the titanium by the winding load must be carefully controlled since excessive prestress reduces the axial load-carrying capacity of the cylinder. Author (TAB)

N67-26877# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Flight Dynamics Lab.
MEASUREMENT AND ANALYSES OF THE J57-P21 NOISE FIELD Technical Report, Nov. 1964–Aug. 1966
P. H. Hermes and D. L. Smith Nov. 1966 135 p refs
(AFFDL-TR-66-147; AD-648072) CFSTI: HC $3.00/MF $0.65

A noise survey of a J57-P21 turbojet engine was conducted to provide a basis for the development of a refined empirical noise prediction technique. The measurements were obtained at 65 locations for 5 engine power settings. The 1/3 octave and overall sound pressure levels (SPLs) for each location and engine power setting are presented. SPL contours are presented for overall and selected 1/3 octave bandwidths. Ground reflection effects on the 1/3 octave band SPLs are evaluated. Comparisons are made with other existing data. Differences of up to 15 decibels (db) are found when comparing the 1/3 octave band levels. Velocity exponents (n), based on the Lighthill parameter, are presented for each location and compared with existing data. Poor agreement is found among the measurement programs. The effect of ground reflection on the n values is investigated and an n field is presented in which interference effects are eliminated. The effect of varying noise directional properties with jet velocity on the n values is evaluated. An n field, corrected for both ground reflection and varying noise directional properties, is presented. This essentially constant n field clearly indicates the heavy dependence of the n values on noise directional changes with jet velocity. The corrected n field equation is considered the basis of a noise prediction method which appears to be accurate for jet flows with exit Mach numbers ranging from 0.5 to 2.0. TAB

N67-26969# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.
DESIGN ANALYSIS OF CENTRAL AND ANNULAR-JET EJECTORS
A. R. Krenkel and H. H. Lipowsky Wright-Patterson AFB, Ohio. ARL. Mar. 1966 105 p refs
(Contract AF 33(657)-8288)
(PIBAL-976; ARL-66-0210; AD-648862) CFSTI: HC $3.00/MF $0.65

An extension of the principles of ejector operation is presented in an analysis which will aid the engineer in designing central- and annular-jet ejectors. Particular attention is focused upon applying the governing conservation equations of mass, momentum and energy to the problem of handling the various regimes of ejector operation. A modified impulse function was deduced which unifies the zero secondary flow and non-zero secondary flow ejector analysis. Application of this function to determine the effects of various influences on ejector performance such as: (a) Mach number regimes of the primary and secondary streams, (b) unequal stream stagnation temperatures, (c) wall friction, (d) the effect of unequal static pressure, was made and results presented. The analysis was applied to estimate the performance characteristics of both central- and annular-jet ejectors and is compared with experimental data in many instances. Systematic ejector operating curves are introduced, and a design analysis is developed therefrom which is rapid and straightforward. It is believed that the analysis and design procedures as applied to annular ejectors is unique. Finally, the performance characteristics of central- and annular-jet ejectors are compared to indicate the suitability of each for given pumping requirements. Author (TAB)

N67-27232*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN EXPERIMENTAL CORRELATION OF THE NONREACTIVE PROPERTIES OF INJECTION SCHEMES AND COMBUSTION EFFECTS IN A LIQUID-PROPELLANT ROCKET ENGINE. PART II. INSTRUMENTATION, EXPERIMENTAL APPARATUS, AND EXPERIMENTAL TECHNIQUES
Richard M. Clayton, Jack H. Rupe, and Fred G. Gerbracht 15 May 1967 39 p refs
(Contract NAS7-100)
(NASA-CR-84302; JPL-TR-32-255) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The details of the experimental apparatus, techniques, and instrumentation for an injection research program utilizing several 20,000-lbf-thrust rocket engines are given. The objectives of the program required the comparison of thermochemical performance, heat transfer, and combustion roughness behavior yielded by nine different injector designs; hence, the interest in accurate measurements was paramount. Following a description of the procedures and equipment, estimates of the achieved accuracies are presented based on a statistical analysis. Author

N67-27238*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
M-1 INJECTOR DEVELOPMENT—PHILOSOPHY AND IMPLEMENTATION
William A. Tomazic, E. William Conrad, and Thomas W. Godwin Washington, NASA, 1967 21 p refs To be Presented at 3d Propulsion Joint Specialists Conf. of the AIAA, Washington, D. C., 17–18 Jul. 1967
(NASA-TM-X-52289) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The injector design was a cooperative effort to achieve high performance with completely stable operation. The approach was based on the technology already established in the RL-10 and J-2 engine development programs. Small-scale tests were conducted to verify the design concepts prior to incorporation into the full-scale hardware. Full-scale injector testing demonstrated that the design goals were achieved. Vacuum specific impulse was approximately 430, which is just above the PFRT goal. The injector was highly resistant to both hydraulic and acoustic instabilities.

Low level "chugging" occurred during the start transient only. Acoustic instability was not encountered until hydrogen injection temperature was reduced below 80°R. Stable operation was restored by raising the hydrogen temperature to 100°R, indicating a substantial margin even under conditions of extreme perturbation (engine design operating temperature is 142°R). Author

N67-27301*# General Motors Corp., Indianapolis, Ind. Allison Div.
PARAMETRIC STUDY OF ADVANCED MULTISTAGE AXIAL-FLOW COMPRESSORS
M. L. Miller and A. C. Bryans Washington, NASA, May 1967 65 p refs
(Contract NAS3-7277)
(NASA-CR-797) CFSTI: $3.00 CSCL 21E

A parametric study of compressor design parameters was made by analyzing results of compressor flow paths for a 9.0:1 overall pressure ratio and 12.0-inch inlet tip radius. The flow paths were computed on the basis of simple radial equilibrium and free vortex design. Energy addition was specified through rotor tip diffusion factor. The rotor tip diffusion factor is reduced if limit values were exceeded on stator hub Mach number, stator hub diffusion factor, and rotor relative exit hub flow angle. Effects of independent parameters defined as tip speed, rotor tip diffusion factor, axial inlet velocity, axial velocity ratio, inlet hub-tip radius ratio, stage efficiency, and ramp angles were evaluated. Author

N67-27309*# Marquardt Corp., Van Nuys, Calif.
PRELIMINARY DESIGN COLUMBIUM COMBUSTOR TEST REPORT
D. W. Fore and G. R. Pfeifer 4 Apr. 1967 94 p
(Contract NAS9-6003)
(NASA-CR-65615; S-595) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Three tests were conducted with each of two combustors: a continuous run test, a pulse operation survey test, and an ignition test. Both combustors accrued over 1,650 seconds of operation and 10,000 starts without exhibiting structural degradation or design deficiencies. Performance and thermal data acquired from the continuous run tests were compared with Apollo S/M RCS test results obtained under similar conditions. This comparison showed that engine performance was unaffected by the use of a columbium combustor and that the injector head steady state and soakback temperatures of the columbium engine configuration were lower than that of the qualified Apollo S/M RCS engine injector head assembly. Both combustors underwent over 600 off-design ignitions (in the vertical-up firing position with saturated propellants) programmed to cause chamber overpressures, without incurring a measurable or observed structural degradation. On the basis of the data generated, the design of the columbium combustor, with its associated attach hardware, is adequate and acceptable without change as the final configuration. Author

N67-27718# Frankford Arsenal, Philadelphia, Pa. Propellant Actuated Devices Lab.
IMPROVED ROCKET WRENCH—FEASIBILITY STUDIES
George P. Miller Dec. 1966 38 p
(M67-9-1; AD-647360) CFSTI: HC $3.00/MF $0.65

Feasibility studies and limited development were performed to add the feature of separation to the present rocket wrench. Various systems to perform this separation were evaluated, and development was started on the appendage type rocket system. Tests to evaluate the wrench were completed, with observations and results documented. Development was suspended because of the decision to extend the testing and evaluation of the present torque wrench. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N67-26631*# National Aeronautics and Space Administration, Washington, D. C.
THE RESULTS OF EXPERIMENTS INVESTIGATING PLASMA IN CIRCUMLUNAR SPACE WITH THE AID OF CHARGED PARTICLE TRAPS ON FIRST ARTIFICIAL LUNAR SATELLITE [REZUL'TATY EKSPERIMENTOV PO IZUCHENIYU PLAZMY V OKOLOLUNNOM PROSTRANSTVE S POMOSHCH' YU LOVUSHEK ZARYAZHENNYKH CHASTITS NA PERVOM ISKUSSTVENNOM SPUTNIKE LUNY]
K. I. Gringauz, V. V. Bezrukikh, M. Y. Khokhlov, G. I. Zastenker, A. P. Remizov et al Feb. 1967 25 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 4, no. 6, 1966 p 851–870
(NASA-TT-F-10737) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Data on plasma in the tail of the earth's magnetosphere at large distances from the earth are presented, as well as data on plasma in the circumlunar space. The apparatus installed in the spacecraft "Luna-10" (four charged particle traps) for the purpose of conducting plasma investigations, and the results of these experiments are described. An analysis is made of the variation in the trap collector currents during the intersection of the earth's magnetosphere tail by the moon. From the measurement data, an estimate is made of the upper limit of possible concentration of thermal charged particles in the lunar ionosphere. Author

N67-26785# Observatoire de Paris (France). Service Solaire.
PART I: RESEARCH ON THE HETEROGENEOUS STRUCTURE OF THE SOLAR ATMOSPHERE. A PROGRESS REPORT, 1964–1966. PART II: LAMBDAMETER NO. 2 Final Scientific Report
R. Michard 31 Oct. 1966 24 p refs
(Contract AF 61(052)-785)
(AFCRL-67-0094; AD-647502) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. THE HETEROGENEOUS STRUCTURE AND THE KINEMATICS OF THE SOLAR ATMOSPHERE. SUMMARY OF THE WORK BY OBSERVATOIRE DE PARIS-MEUDON, 1964–1966 p 3–7 refs (See N67-26786 14-29)

2. LAMBDAMETER NO. 2 p 8–22 refs (See N67-26787 14-14)

N67-26786# Observatoire de Paris (France). Service Solaire.
THE HETEROGENEOUS STRUCTURE AND THE KINEMATICS OF THE SOLAR ATMOSPHERE. SUMMARY OF WORK BY OBSERVATOIRE DE PARIS-MEUDON, 1964–1966
In its Pt. I: Res. on the Heterogeneous Struct. of the Solar Atmosphere 31 Oct. 1966 p 3–7 refs (See N67-26785 14-29)

Research focusing on the development of instrumentation for the spectrographic observation of the fine structure of the atmosphere is discussed; and observational results and data analyses resulting from studies of photospheric inhomogeneities, chromospheric structure, magnetic fields of the sun, and problems of the heterogeneous structure of the solar atmosphere; are reviewed. S.C.W.

N67-27012# Manchester Univ., Macclesfield (England). Nuffield Radio Astronomy Labs.

OBSERVATIONS OF GALACTIC AND EXTRA-GALACTIC EMISSION AT 408 Mc/s. THE DETERMINATION OF THE ACCURATE POSITIONS OF RADIO SOURCES BY THE LUNAR OCCULTATION TECHNIQUE. OBSERVATIONS OF EMISSION FROM FLARE STARS Progress Report, Oct.–Dec. 1965

C. G. T. Haslam, M. J. S. Quigley, A. G. Lyne, and A. C. B. Lovell Dec. 1965 6 p refs

(Contract N62558-3928)

(PR-1; AD-648576) CFSTI: HC $3.00/MF $0.65

Operational and instrumentational aspects of a 408 Mc/s survey with the Mk I telescope at Jordell Bank are reviewed. Progress is reported in the effort to develop a complete interferometer system capable of permitting simultaneous observations at 151, 408, and 1420 Mc/s. The flare star project was inactive. TAB

N67-27252# Osservatorio Astronomico di Roma (Italy).

SOLAR PHENOMENA

Massimo Cimino Mar. 1967 22 p *Its* Monthly Bull. No. 111

Several tables are presented on astronomical observations of solar phenomena recorded at the observatory in Rome. Data are recorded for daily total areas of sunspot groups; heliographic position, classification and area of sunspot groups; and longitudinal sunspot magnetic fields. Hours of K-line cinematographic patrol; hours of H_α cinematographic patrol are also presented. R.Ll.

N67-27370*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

MARTIAN IONOSPHERE: A COMPONENT DUE TO SOLAR PROTONS

Carl Sagan and Joseph Veverka Apr. 1967 14 p refs

(Grant NGR-09-015-023)

(NASA-CR-84411; Rept.-703-24) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The small magnetic field strength observed by Mariner 4 near Mars suggests that protons from the solar wind may enter the Martian atmosphere and produce ionization in addition to that produced by ultraviolet light and X-rays. It is found that solar protons produce a thin ionized layer at a rate $\approx 3\times10^3$ cm^{-3} sec^{-1} at a depth corresponding to the F_1 region in the terrestrial atmosphere. Unless the effective recombinative coefficient is very large ($>10^{-5}$ cm^3 sec^{-1}), or unusual diffusion effects are present, this layer should have been detected by Mariner 4, and therefore must be present in one of the observed ionized regions. Because of its very compact shape, the subsidiary maximum near 95 km discovered in the Mariner-4 occultation experiment may be the proton ionization peak. If so, the major 120-km maximum is an F_2 layer. Distinction between photon and proton ionization regions can be made by microwave occultation experiments aboard planetary orbiters. Author

N67-27518*# Volt Technical Corp., Washington, D. C.

CONTRIBUTION TO THE STUDY OF THE RELATIONSHIPS BETWEEN SOLAR AND GEOMAGNETIC ACTIVITIES [CONTRIBUTION A L'ETUDE DES RELATIONS ENTRE LES ACTIVITIES SOLAIRE ET GEOMAGNETIQUE]

B. Bednarova-Novakova 11 May 1967 9 p refs Transl. into ENGLISH from J. of Atmospheric and Terrest. Phys. (No. Ireland), v. 29, 1967 p 377–384

(Contract NAS5-12487)

(NASA-CR-84464; ST-SP-6M-10605) CFSTI: $3.00 CSCL 03B

The necessary conditions are stated under which geomagnetic storms arise, as revealed by solar observations. The new criteria do not conflict with those previously developed, based on other phenomena. A method for forecasting geomagnetic activity has been elaborated, enabling a sudden commencement to be predicted with great accuracy. It makes possible the forecasting of geomagnetic storms in each period of the solar cycle, and to say in advance whether the onset of a given storm will be sudden or gradual. As examples for explaining their origin, use was made of the SC-geomagnetic storms of 11 February 1958, 20 September 1959, 29 October 1963, and 22 November 1963. Except for the first, all these storms had been predicted on the basis of solar observations by means of the spectroheliroscope. The origin of the gradual-onset geomagnetic storm of 6 and 7 October 1960 is explained, which had likewise been predicted. On the same principles explanations are given of the geomagnetic quiet period of 19–25 June 1965, which recurred six times (16–17 July, 13 August, 8–9 September, 6–7 October, 1–3 November, and 28–29 November 1965) and of the one that occurred on 31 December 1965 and 1 January 1966, and on 27–28 January 1966. Author

N67-27585*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GALACTIC X-RAYS. (A SUMMARY PREPARED FOR THE 1968 YEARBOOK OF SCIENCE AND TECHNOLOGY, McGRAW-HILL)

Elihu Boldt May 1967 8 p refs

(NASA-TM-X-55795; X-611-67-222) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Presented is the status of galactic X-ray investigations by rocket and balloon borne observations from the upper atmosphere. At rocket altitudes of $\geq$ 300,000 feet the observed flux from galactic X-ray sources is limited only by interstellar gas. Thin window gas counters at lower energies and alkali halide scintillation crystals at upper energies provide the required high detection efficiency for measurements of galactic objects. Spectral measurements of Sco X-1 source showed consistency with transparent thermal plasma emissions at temperatures of 5 ± 10^7 K; the X-ray spectrum from the quiet sun was an order of magnitude lower than the temperature for Sco X- at $4.5\times10^{8\pm}$K. The Crab nebula (Tau A) is the only X-ray source exhibiting strong emission in both the optical and radio regions. In general, X-ray sources are attributed to remnants of supernovae and are mostly clustered towards the galactic center at an average of $\pm$ 3.5 degrees from the galactic plane and at an average distance of 8 ± 10^3 light years from earth. G.G.

N67-27683*# Maryland Univ., College Park. Dept. of Physics and Astronomy.

A REFORMULATION OF THE COSMIC RAY SOLAR MODULATION PROBLEM

G. Skadron Apr. 1967 32 p refs

(Grant NsG-695)

(NASA-CR-84504; TR-678) CFSTI: $3.00 CSCL 20H

The propagation of galactic cosmic rays in the interplanetary medium is examined and a transport equation for the cosmic ray energy spectrum is derived. By constructing a Boltzmann equation for the cosmic ray phase space distribution function and by taking velocity moments over directions in momentum space, the continuity and momentum conservation equations for each energy element of the cosmic ray gas are obtained. The effect of scattering on the distribution function is treated by a Fokker Planck equation while the effect of scattering on the differential streaming velocity is treated by means of a relaxation approximation. By linearizing the momentum equation, expressions are obtained for the differential streaming velocity at an arbitrary point in the medium in terms of the local energy spectrum. The value of the first Fokker Planck coefficient is evaluated and found to represent adiabatic cooling of the cosmic ray gas while an additional deceleration arises from streaming along a polarization electric field. The resulting transport equation for the energy spectrum reduces to the Parker's equation in the absence of the interplanetary polarization electric field. Author

N67-27778 National Physical Lab., New Delhi (India). Radio Propagation Unit.
SOLAR AND GEOPHYSICAL DATA, PART 2
Jan. 1967 13 p
(RRC-A139, Pt. 2)

The tabulated data presented include: 1) predicted and observed sunspot numbers, 2) 100 Mc/s and 2,000 Mc/s solar fluxes, 3) solar flares, 4) solar flare effects, 5) magnetic storms, and 6) ionospheric effects of solar flares. The data are all for the period December 1966. In addition, diagrams of the SID events are given. L.S.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N67-26483 Observatorium Bosscha, Bandung (Indonesia).
A CATALOGUE OF NEW H-ALPHA EMISSION STARS IN THE ETA CARINAE NEBULA REGION
Pik-Sin The Jul. 1966 22 p refs *Its* Contrib. from the Bosscha Obs. No. 35
CFSTI: $3.00

Two hundred and thirty one new H-alpha emission stars have been found in a region of about 55 square degrees centered at R.A. = 10^h40^m; Dec. = −59° (1950). Their positions and identification charts are given. Author

N67-26497# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ORBITAL ELEMENTS FROM DOPPLER OBSERVATIONS OF THE SATELLITE GEOS-A
E. Kathryn Kerbel Dec. 1966 11 p refs
(Contract NOw-62-0604-c)
(TG-862; AD-648320) CFSTI: HC $3.00/MF $0.65

The paper lists the mean Kepler elements, determined from doppler measurements from the TRANET system, for the satellite GEOS-A (1965-89A) from its launch on November 6, 1965 through November 29, 1966. Because of the small precession rate, the table does not span a full period of the precession of perigee. Author (TAB)

N67-26507*# Ludwig-Maximilians-Universitat, Munich (West Germany).
ON THE INFLUENCE OF ATMOSPHERIC TRANSMISSION FUNCTIONS ON INFRARED MEASUREMENTS IN PLANETARY ATMOSPHERES, PART II Final Report
I. Tannhaeuser Jan. 1967 75 p refs
(Grant NsG-305)
(NASA-CR-84157) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Various methods to represent atmospheric radiation spectra and discrepancies in the results are discussed. A comparison is made of present calculations in the 4.5 micron region, where the bands of CO_2, N_2O, and CO are overlapping. The difference of calculated equivalent temperatures of the outgoing radiation are seen to be higher than 8°K. Approximate calculations in the Nimbus I HRIR region (3.4 to 4.2 micron) show that the bands of CO_2 and N_2O can be responsible for observed discrepancies. These gases account for about 2°K of the equivalent temperature. Detailed results for clouds of various heights and emissivities are tabulated. Approximate calculations in the long wave length wing of the 6.3 micron H_2O-band show that the neglection of N_2O and CH_4 against the H_2O transmission may cause an error of about 9°K between 7.25 and 7.75 microns. A general method for the representation of atmospheric spectra is given, based on laboratory transmission functions. Its applicability to the 1306/1550 CH_4, 2563/2461 N_2O, 3020 CH_4, 2143 CO, 2224 N_2O-bands, and the 6.3 micron H_2O and 4.3 micron CO_2-bands is demonstrated. Author

N67-26511*# Bellcomm, Inc., Washington, D. C.
CRATER STATISTICS AND EROSION
R. J. Collins and B. G. Smith 3 Mar. 1967 25 p refs Presented at the AAS Symp. on the Phys. of the Moon, Washington, D. C., 29 Dec. 1966
(Contract NSR-24-005-047)
(NASA-CR-84153; TR-67-340-1) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A review is presented of the essential features of lunar cratering statistics and their interpretation in terms of the meteoroid impact hypothesis. The crater size distribution function is introduced. A simple model is used to discuss the concept of crater lifetime and the mechanisms for its limitation, with relevance to the existence of saturated surfaces and equilibrium distribution functions. Secondary cratering and its importance are considered. It is pointed out that several different theoretical models adequately match the measured distributions and that this argues against the exclusive justification of any one model. The conclusion is drawn that a nonequilibrium distribution function should contain information about the crater production process but that an equilibrium distribution may be sensitive primarily to local surface properties. Author

N67-26522*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
INTRODUCTION
Robert G. Stern *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 7–11 refs (See N67-26521 14-21)

An abbreviated outline of NASA-sponsored research activity at the Experimental Astronomy Laboratory is presented. During the past two years, research has been in the following fields: midcourse guidance, optimization, statistical filtering, mission planning, navigation, applied mathematics, astrophysics, inertial sensors, and test equipment. R.U.

N67-26523*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
A NEW SOLUTION TO LAMBERT'S PROBLEM
Wai K. Lim *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 13–18 refs (See N67-26521 14-21)

In comparison with the classical method and the uniform variable method, a new solution to Lambert's problem is presented. In this method, the series representation of the solution involves only the sine function (or hyperbolic sine in the case of hyperbolic transfer). An advantage of this form of flight time equation is the simplicity of the equation when time is normalized with respect to the physical quantity specified and the geometry is represented by a single parameter. A test program was written for the IBM 7094 computer. With the same input data, it solved Lambert's problem using each of three methods in sequence. In regard to convergence and accuracy, the Lambert method is considered comparable with the uniform variable method. R.U.

N67-26527*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
OPTIMAL MULTIPLE-IMPULSE ORBITAL RENDEZVOUS
John Prussing *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 39–44 refs (See N67-26521 14-21)

A midcourse trajectory impulse to reduce satellite fuel consumption is considered. The necessary conditions for a minimizing fuel orbital transfer are described in terms of the primer vector, the adjoint to the first order variation in velocity. From a solution for the primer vector which satisfies the conditions for an optimal transfer, the times of applications and the directions of the thrust impulses are obtained. The magnitudes of the impulses must then be determined by solving the boundary value problem for the rendezvous. R.LI.

N67-26528*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

OPTIMAL CONTROL IN THE PRESENCE OF MEASUREMENT UNCERTAINTIES

John Deyst *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 45–49 (See N67-26521 14-21)

The problem is considered of optimal control of linear stochastic systems when the information available to the controller contains random disturbances. Problems for which the cost may be a non-quadratic function of the state variables and/or the control variables are emphasized. A system of equations is derived to describe discrete problems. The theory outlined was applied to the problem of minimum mean fuel for midcourse guidance corrections of spacecraft. It is stated that the numerical solution of such problems becomes extremely difficult as the number of state variables increases. R.LI.

N67-26534*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

AN APPLICATION OF MATCHED ASYMPTOTIC EXPANSIONS TO HYPERVELOCITY FLIGHT MECHANICS

Richard F. Willes (AF Acad.) *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 85–87 refs (See N67-26521 14-21)

The matched asymptotic expansion method extended to the area of entry dynamics or hypervelocity flight mechanics is briefly described. Previous work in flight mechanics is used in an approximation of the range of validity and accuracy of new solutions, and previous solutions are improved by extension to higher order. All regions of behavior of the dynamic equations for two-dimensional flight in a non-rotating atmosphere surrounding a spherically symmetric planet were previously exhaustively mapped, and the approximate lowest order approximations to the dynamic equations identified. The investigation is also reported to have devised a method permitting analytical calculation of optimal entry trajectories. The major contribution reviewed is considered to be the demonstration of the usefulness of the method of matched asymptotic expansions as an analytical tool for investigating currently interesting problems in hypervelocity flight mechanics. R.LI.

N67-26535*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

THE ROTATION OF THE PLANET MERCURY

Charles Counselman *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 89–93 refs (See N67-26521 14-21)

Since radar observations of Mercury disclosed a different time period for the planet's axial rotation, an investigation was undertaken to discover the implications for new theories of the solar system, and of the inner planets in particular. The axial rotation period was adjusted to 59±3 days, and a number of explanations of this new result was reviewed. R.LI.

N67-26559*# Douglas Aircraft Co., Inc., Santa Monica, Calif.

HANDBOOK OF THE PHYSICAL PROPERTIES OF THE PLANET JUPITER

C. M. Michaux Washington, NASA, 1967 140 p refs (Contract NASw-1013) (NASA-SP-3031) GPO: $0.60 CSCL 03B

The present observational knowledge of Jupiter is summarized, and the results of numerous theoretical studies are outlined. Topics covered include its large mass and low mean density; chemical composition; diameter and shape; rate and axis rotation; surface gravity; internal structure; electromagnetic and particle fields; temperature; radio frequency radiation; optical properties; cloud markings; atmospheric composition, structure, circulation, depth, and surface; possible existence of a form of primitive life; and the inner and outer systems of the 12 Jupiter satellites. A glossary of terms and a reference bibliography are also presented. M.G.J.

N67-26620*# Columbia Univ., New York. Columbia Radiation Lab.

RADIO AND X-RAY ASTRONOMY

In its Res. Invest. Directed Toward Extending the Useful Range of the Electromagnetic Spectrum 31 Oct. 1966 p 93–102 refs (See N67-26616 14-20)

Radio and X-ray astronomy research is briefly outlined under the trichotomy: X-ray telescope, X-ray polarization, and models of planetary atmospheres. Microwave absorption coefficients measured for mixtures of carbon dioxide with nitrogen and argon, and water vapor with nitrogen were applied to an analysis of the observed microwave emission spectrum of Venus with regard to the composition and structure of its atmosphere. It is reported that from spectroscopic evidence, the only gases definitely identified in the Venus atmosphere are carbon dioxide and, in very small amounts, water vapor. A large-area X-ray collector is reported for flight in an Aerobee 150 sounding rocket. R.LI.

N67-26627*# National Aeronautics and Space Administration, Washington, D. C.

APPLICATION OF THE PONTRYAGIN MAXIMUM PRINCIPLE TO FLIGHT IN A VACUUM [ANWENDUNG DES PONTRJAGINSCHEN MAXIMUMPRINZIPS AUF FLUEGE IM LUFTLEEREN RAUM]

G. Steinmetz Feb. 1967 9 p ref Transl. into ENGLISH from the German Report, Dec. 1965 (NASA-TT-F-10745) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Consideration is given to methods of determining fuel-optimum ascent trajectories in a vacuum (classical calculus of variations, Pontryagin maximum principle, dynamic programming, gradient method). It is found that the Pontryagin maximum principle has distinct advantages over the other methods. The mathematical relationships for the application of the principle to the title problem are derived. The difficulties encountered are discussed. Author

N67-26641* National Aeronautics and Space Administration, Washington, D. C.

EARTH PHOTOGRAPHS FROM GEMINI III, IV, AND V

1967 262 p refs (NASA-SP-129) GPO: $7.00 CSCL 06B

A collection of 244 color earth photographs from Gemini III, IV, and V are presented. Most of the pictures were obtained by Gemini IV and V in a series of synoptic weather and synoptic terrain photography experiments, formally scheduled to obtain high-quality color photos of terrain features and cloud systems for geological, geographical, and meteorological purposes. On the Gemini IV flight priority was given to photography of east Africa, the Arabian Peninsula, Mexico, and the southwestern U.S. For Gemini V the selected land and near-shore areas were chosen not only for geologic study, but also for geographic and oceanographic investigations. Although earth-science photographs were not formally scheduled on Gemini III, astronauts took 25 pictures, most of which showed cloud formations. Photographs are arranged in orbital

sequence. Details concerning length of flight, apogee and perigee, crew, number of photos taken, and photographic equipment used preface each section. Captions accompanying the pictures identify political subdivisions, geographic features, and in some cases discuss geological and meteorological phenomena. S.P.

N67-26674# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
BIBLIOGRAPHY OF LUNAR AND PLANETARY RESEARCH - 1965
J. W. Salisbury, ed. Jan. 1967 183 p refs *Its* Special Reports, No. 55
(AFCRL-67-0043; AD-648463)

A bibliography of lunar and planetary research articles published during 1965 is presented with both subject and author listings. The major subject categories are: astrobiology, comets, meteorite craters and cratering effects, meteors and meteorites, the moon, origin of the solar system, the planets, and tektites. Each article is abstracted. Author (TAB)

N67-26871# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE MECHANICAL ELLIPTICITIES OF THE MOON FROM LUNA 10
C. L. Goudas Jan. 1967 8 p refs *Its* Mathematical Note No. 498
(DI-82-0595; AD-648146) CFSTI: HC $3.00/MF $0.65

The published estimates of 11 coefficients of the force function of the Moon obtained from the motion of Luna 10 are used to determine the mechanical ellipticities of the Moon. It is concluded that the Moon departs more from a condition of hydrostatic equilibrium than previous estimates have indicated. Also, its density is very close to being constant with a very slight increase with depth. This invalidates the recently advanced hypothesis that the density decreases with depth because of an excess in the motion of the nodal line of the lunar orbit. Author (TAB)

N67-26978*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GODDARD 1965—A YEAR IN REVIEW AT GODDARD SPACE FLIGHT CENTER NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
[1965] 116 p
(NASA-TM-X-59680) CFSTI: HC $3.00/MF $0.65 CSCL 22D

A chronological sequence of satellite launchings and accomplishments of 1965 in the aerospace field is presented. Satellite data are briefly summarized, and the space tracking and data acquisition network is illustrated. Other illustrations include charts of the manned space flight network, the first complete view of the world's weather, island tracking stations around the world, and ground support network. Missions and careers for scientists and engineers are cited. Launch, orbit, and experiment data from each satellite and space probe launched during the year are tabulated. S.P.

N67-27042# RAND Corp., Santa Monica, Calif.
PLANETARY CONTAMINATION. II: SOVIET AND U.S. PRACTICES AND POLICIES
Bruce C. Murray, Philip K. Eckman (Calif. Inst. of Tech.), and Merton E. Davies Mar. 1967 25 p refs
(AD-648864) CFSTI: HC $3.00/MF $0.65

It was concluded that viable terrestrial micro-organisms which are transported to Mars inside solid components in sealed spaces have a low probability of being released to the surface or atmosphere, and if any are released they are not likely to infect the planet. TAB

N67-27049# General Electric Co., Philadelphia, Pa. Missile and Space Div.
THE MAGNETOSPHERE OF THE PLANET MERCURY AS A SCATTERING CENTER FOR SOLAR FLARE PROTONS
R. C. Good, Jr. Mar. 1967 18 p refs
(R67SD4; AD-809122) CFSTI: HC $3.00/MF $0.65

The planet Mercury is postulated to have a magnetic dipole moment which interacts with the solar wind producing a magnetosphere. This contained magnetic field scatters solar flare high energy protons. Two features are needed to deflect protons toward Earth: Mercury must be in the proton stream, and trajectory deflection angles required should not be large. Between 1955 and 1965 there were 30 solar proton events recorded at Earth. At those times, Mercury was less than forty degrees in longitude from the flares 14 times instead of the expected number 8. Similar positional data for Venus shows no preference for positions suitable for scattering and therefore is not expected to influence the proton flux at Earth. To determine trajectory deflection angles, the differential equations of motion for protons were solved for the trajectories within and at exit from the magnetosphere. The scattered flux was found to have maxima at deflection angles of five and eighty degrees counterclockwise and 160 degrees clockwise. A magnetic moment only 0.15% of Earth's was used in the calculations, which is reasonable. The 80° angle compares well with astronomical data on the relative positions of Earth and Mercury during solar proton events. Author (TAB)

N67-27085*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
RADIO ASTRONOMY
In its Res. Lab. of Electron. 15 Apr. 1967 p 15–26 refs (See N67-27081 14-23)
(Contract DA-28-043-AMC-02536(E))

In a radio astronomical study, an interpretation of microwave spectral data is presented. Results obtained from the inversion of simulated atmospheric water-vapor spectra are presented together with details of the microwave dielectric constant and emissivity of a solution approximating sea water. Also reported was the first observational phase of a program to make a survey of radial velocities of H II regions throughout the galaxy. In another study, an observation of the ground-state emission lines of $O^{16}H^{1}$ at 18 cm near galactic H II regions showed that the apparent diameters of the emitting regions are very small. R.U.

N67-27132 Bolkow Entwicklungen K. G., Munich (West Germany).
MISSION ANALYSIS OF A COMET PROBE [MISSIONS-ANALYSE VON KOMETENSONDEN]
W. Mueller 6 Sep. 1966 41 p refs In GERMAN
(RF-73OE)

This review of objectives and instrumentation for cometary probes considers the energy, time, and physical criteria that limit observation possibilities of space vehicles. Calculations on relative velocity of the sonde in relation to the comet system were performed and estimates were obtained for the expected brightness factor during start and contact. Transl. by G.G.

N67-27174*# General Precision, Inc., Little Falls, N. J.
PERIODIC AND ALMOST PERIODIC TRAJECTORIES IN CISLUNAR SPACE Final Report
Apr. 1967 87 p refs
(Contract NAS8-20062)
(NASA-CR-83983) CFSTI: $3.00 CSCL 22C

CONTENTS:

1. FINITE TIME STABILITY OF PERIODIC SOLUTIONS OF HAMILTONIAN SYSTEMS PROGRESS REPORT I. S. Bernstein 17 p refs (See N67-27175 14-30)

2. BIRKHOFF NORMALIZATION PROCESS PROGRAM FOR TIME-INDEPENDENT HAMILTONIAN SYSTEMS W. A. Chai and S. Kass 48 p refs (See N67-27176 14-30)

3. A CONCEPT FOR SPACE FLIGHT SAFETY P. B. Richards 9 p (See N67-27177 14-30)

N67-27175*# General Precision, Inc., Little Falls, N. J.

FINITE TIME STABILITY OF PERIODIC SOLUTIONS OF HAMILTONIAN SYSTEMS Progress Report

I. S. Bernstein *In its* Periodic and Almost Periodic Trajectories in Cislunar Space Apr. 1967 17 p refs (See N67-27174 14-30)
(PR-8)

This study deals with finite time stability properties of periodic solutions of Hamiltonian systems. It attempts to answer questions such as what tube of initial conditions about the periodic solution will keep solutions in some prescribed tube about the periodic solution over some prescribed time interval. A theoretical basis for answering questions such as the one formulated above was given by Birkhoff. However, to obtain actual numerical estimates from the analytical theory requires a great deal of algebraic manipulation even in the simplest of problems. For this reason, it was decided to employ a computer and an appropriate computer language to perform the required manipulations. As an initial application of the mechanization of the Birkhoff theory the system chosen was the planar restricted three-body problem and the solution chosen was a Lagrangian critical point. Author

N67-27176*# General Precision, Inc., Little Falls, N. J.

BIRKHOFF NORMALIZATION PROCESS PROGRAM FOR TIME-INDEPENDENT HAMILTONIAN SYSTEMS

Winchung A. Chai and Sheldon Kass *In its* Periodic and Almost Periodic Trajectories in Cislunar Space Apr. 1967 48 p refs (See N67-27174 14-30)
(Contract AF 49(638)-1466)
(AFOSR-67-0123)

This is a complete documentation (program description) of a computer package for analyzing finite time stability properties of equilibrium points of time-independent Hamiltonian systems. Using this package, approximate analytic solutions which contain nonlinear effects can be constructed near these equilibrium points. Three main programs constitute the complete package. The first program normalizes and computes the generating functions for a time-independent Hamiltonian in the neighborhood of an equilibrium point, the second expresses coordinate transformations as truncated power series, and the third program computes point-by-point coordinate transformations. To demonstrate the procedure, this report describes in detail the application of the computer package to the construction of solutions of the planar restricted three-body problem near the L_4 equilibrium point. Numerical results compare very favorably in precision with values obtained by numerical integration. The computer time required for the entire normalization process is only a small fraction of the integration time, however. Author

N67-27177*# General Precision, Inc., Little Falls, N. J. Aerospace Group.

A CONCEPT FOR SPACE FLIGHT SAFETY

Paul B. Richards *In its* Periodic and Almost Periodic Trajectories in Cislunar Space Apr. 1967 9 p Presented at Canaveral Council of Tech. Soc., 4th Space Congr., Cocoa Beach, Fla., 3–6 Apr. 1967 (See N67-27174 14-30)

Presented is a preliminary report of an exploratory study of a space flight safety concept which is based on the utilization of manned or unmanned space vehicles prepositioned in periodic space flight trajectories on routine mission assignments. A periodic trajectory is a trajectory which repeats its motion at regular intervals. The fundamental idea behind the concept is to provide outside assistance to a manned spacecraft such as an Apollo as quickly as possible, using vehicles already in space. Responsibility for specific space flight safety operations would be assigned to various vehicles in periodic trajectories. This investigation of space flight safety is one part of a large program designated the Orpheus Program, which is proposed for the exploitation of periodic space flight trajectories. Preliminary calculations indicate that a rescue vehicle can be so prepositioned in a periodic orbit encompassing the earth and the moon that upon receipt of the Apollo distress signal, the rescue vehicle can leave its orbit and rendezvous with the Apollo in three to ten hours or less. It is possible that this rescue operation can be achieved with boosters and capsules that are currently operational or under test. On the basis of these findings it is recommended that this Orpheus concept for space flight safety be vigorously pursued in order to achieve operational flight safety procedures as quickly as possible. S.C.W.

N67-27229*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

A PRELIMINARY ANALYSIS OF ORBIT INSERTION GUIDANCE FOR THE VOYAGER MISSION

Cort R. Flint 26 Apr. 1967 23 p refs
(NASA-TM-X-53601) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The terminal orbit insertion guidance maneuver for the Voyager mission was investigated. The study consists of two parts: a comparison of four types of possible guidance laws in terms of propellant efficiency with an optimum thrust program; and an analysis of the accuracy characteristics of two of these schemes. This analysis was done by introducing navigation and implementation errors into these two guidance laws and observing the resulting error in the parameters of the terminal orbit. The gravity-turn law and constant direction in inertial space law, which compared favorably with the optimum thrust program, were used in the accuracy analysis. Both laws responded adequately to the induced errors without critical results. It was concluded that the preferred law would probably be the constant inertial law because it is the easier to mechanize. Author

N67-27239*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MANNED VENUS ORBITING MISSION

Edward A. Willis, Jr. Washington, NASA, 1967 21 p refs
(NASA-TM-X-52311) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Manned orbiting stopover round trips to Venus are studied for departure dates between 1975 and 1986 over a range of trip times and stay times. The use of highly elliptic parking orbits at Venus leads to low initial weights in Earth orbit compared with circular orbits. For the elliptic parking orbit, the effect of constraints on the low altitude observation time on the initial weight is shown. The mission can be accomplished with the Apollo level of chemical propulsion, but advanced chemical or nuclear propulsion can give large weight reductions. The Venus orbiting mission can be done for lower initial weights than the corresponding Mars mission. Author

N67-27277*# National Aeronautics and Space Administration, Washington, D. C.

NEW METHODS OF CELESTIAL MECHANICS. VOLUME I: PERIODIC SOLUTIONS, THE NON-EXISTENCE OF INTEGRAL INVARIANTS, ASYMPTOTIC SOLUTIONS

H. Poincare Apr. 1967 337 p Transl. into ENGLISH of the book "Les Methodes Nouvelles de la Mecanique Celeste. Tome I. Solutions Periodiques, Non-existence des Integrals Uniformes, Solutions Asymptotiques" New York, Dover Publ., 1957
(NASA-TT-F-450) CFSTI: HC $3.00 CSCL 03C

The Three-Body Problem is of such importance in astronomy, and is at the same time so difficult, that all efforts of geometers have long been directed toward it. A complete and rigorous integration being manifestly impossible, we must turn to the processes of approximation. The methods first employed consisted of seeking developments in terms of powers of the masses. These

methods, which consist of developing the coordinates of the heavenly bodies in terms of the powers of the masses, have in fact, a common character which is opposed to their use for long-term calculation of the ephemerides. The series obtained contain terms called secular, where time occurs outside the sine and cosine terms. Author

N67-27278*# National Aeronautics and Space Administration, Washington, D. C.
NEW METHODS OF CELESTIAL MECHANICS. VOLUME II: METHODS OF NEWCOMB, GYLDEN, LINDSTEDT, AND BOHLIN
H. Poincare Apr. 1967 420 p refs Transl. into ENGLISH of the book "Les Methodes Nouvelles de la Mecanique Celeste, Tome II. Les Methodes de Newcomb, Gylden, Lindstedt, et Bohlin" New York, Dover Publ., 1957
(NASA-TT-F-450) CFSTI: HC $3.00/MF $0.65 CSCL 03C

The methods of celestial mechanics, the methods by Newcomb, Gyldén, Lindstedt, and Bohlin are discussed in detail, including historical background, application to the study of secular variations, to the three-body problem, to orbits of low eccentricity, and to ordinary and libration cases. The difficulties and advantages of the various methods are discussed and extensions of the procedures are developed. The Gyldén methods are demonstrated to be the most precise and best applicable to the orbits of minor planets perturbed by Jupiter. The usefulness of so-called divergent series in astronomy, specifically in the three-body problem, is indicated. Trigonometric series, of the Newcomb and Lindstedt form, are derived that formally satisfy the equations that define the secular variations, applicable to the n-body problem and to the stability of the solar system. For three bodies moving in the same plane, canonical equations with only one degree of freedom and integratable by simple quadrature are given. Author

N67-27279*# National Aeronautics and Space Administration, Washington, D. C.
NEW METHODS OF CELESTIAL MECHANICS. VOLUME III: INTEGRAL INVARIANTS, PERIODIC SOLUTIONS OF THE SECOND TYPE, DOUBLY ASYMPTOTIC SOLUTIONS
H. Poincare Apr. 1967 406 p Transl. into ENGLISH of the book "Les Methodes Nouvelles de la Mecanique Celeste. Tome III. Invariants Integraux. Solutions Periodiques du Deuxieme Genre. Solutions Doublement Asymptotiques" New York, Dover Publ., 1957
(NASA-TT-F-452) CFSTI: HC $3.00 CSCL 03C

Integral invariants are introduced using the steady motion of the fluid as an example. The usefulness of invariants in celestial mechanics is demonstrated. Various forms of the three-body problem are treated. Poisson stability is defined for the steady motion of a liquid, the general and restricted three-body problem. The theory of "consequents" is introduced in the discussion. The existence, stability, and properties of periodic solutions of the second type are treated. These are related to the principle of least action and the Darwin orbits. The concepts of kinetic focuses and Maupertius focuses are introduced in the discussion. Periodic solutions of the second type are treated. Homoclinous and heteroclinous doubly asymptotic solutions are discussed for the three-body problem. Author

N67-27297*# National Aeronautics and Space Administration, Washington, D. C.
LUNAR SURFACE STUDIES—A CONTINUING BIBLIOGRAPHY WITH INDEXES
Apr. 1967 66 p refs
(NASA-SP-7003(03)) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A continuing bibliography on Lunar Surface Studies contains references to research in the theory of lunar origin, the lunar atmosphere and geological and topographical characteristics, lunar observation techniques, and instrumentation and equipment. The abstracts are presented chronologically, from February 1966 through January 1967, in two groups; those previously announced in the Scientific and Technical Aerospace Reports of NASA, and those from the International Aerospace Abstracts. Both a subject and an author index are included. M.W.R.

N67-27376*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
A CRITICAL TEST OF THE ELECTRICAL DISCHARGE MODEL OF THE VENUS MICROWAVE EMISSION
James B. Pollack and Carl Sagan Jan. 1967 15 p refs
(Grant NGR-09-015-023)
(NASA-CR-84417; Rept.-612-8) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The consistency of the electrical discharge model with the Mariner 2 microwave observations is tested within the constraints set by ground-based measurements. Conclusions are that the model of the microwave emission is in strong disagreement with the Mariner 2 observations. The model of the planet invoking a hot surface overlaid by water clouds is consistent not only with the Mariner 2 observations, but also with the microwave phase and interferometric observations and the radar data. C.T.C.

N67-27384 Joint Publications Research Service, Washington, D. C.
CONSTRUCTION OF NEW RADIOTELESCOPE COMPLETED AT SERPUKHOV
28 Mar. 1967 5 p Transl. into ENGLISH from Smena (Moscow), no. 1, Jan. 1967 p 17
(JPRS-40433; TT-67-31078) CFSTI: $3.00

The discovery of quasar ZS-9; and a radio emission of 10 billion years of age, recorded by the radio telescope, is reported. Areas in astronomy to which the radio telescope can be applied; such as studies of quasars, cosmic radio frequency radiation, and stellar explosions, are discussed. L.S.

N67-27422*# Brown Engineering Co., Inc., Huntsville, Ala.
DIRECTIONAL CHARACTERISTICS OF LUNAR THERMAL EMISSION
C. G. Montgomery, J. M. Saari, R. W. Shorthill, and N. F. Six, Jr. Nov. 1966 96 p refs Prepared in cooperation with Boeing Co., Seattle
(Contract NAS8-20166)
(NASA-CR-84449; D1-82-0568; TN-R-213; AD-647179) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Preliminary studies of the directional characteristics of lunar thermal emission have been completed using existing infrared lunation data. Brightness temperatures were obtained at every 10C interval of a thermal latitude and longitude grid system where the subsolar point was defined as the thermal north pole, the antisolar point as the thermal south pole, and the thermal prime meridian as passing through the apparent disk center. The results are presented in the form of a family of plots of brightness temperature versus thermal coordinates. Comparisons with the lambert diffuse surface law are made. Author (TAB)

N67-27424*# Socony Mobil Oil Co., Inc., Dallas, Tex. Research Dept.
NEUTRON DIE-AWAY EXPERIMENT FOR LUNAR AND PLANETARY SURFACE ANALYSIS Final Report, 26 Jul. 1966–26 Mar. 1967
W. R. Mills, Jr. and W. W. Givens 26 Apr. 1967 120 p refs
(Contract NASw-1435)
(NASA-CR-84447; CO-271-C-RES-(9-66)) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The feasibility studies involved measurements under a variety of conditions of the die-away of neutrons and gamma rays as produced by a pulsed-neutron source and as measured by suitable detectors. In each case, the source and detector were placed on

the surface of one of several rock models which are effectively semi-infinite. Tentative conclusions of the study include (1) from either a gamma ray or thermal neutron die-away curve for a given geometrical configuration, the macroscopic absorption cross section may be determined, (2) epithermal die-away curves respond primarily to hydrogen and they show a proper and very sensitive response to hydrogen, and (3) gamma ray and thermal neutron die-away curves reflect a relatively deep material averaging capability. C.T.C.

N67-27479# Mitre Corp., Bedford, Mass.
ON THE MOTION OF AN ARTIFICIAL EARTH SATELLITE
James B. Frazer Sep. 1966 58 p refs
(Contract AF 19(628)-5165)
(MTR-208; ESD-TR-66-293; AD-640315) CFSTI: HC $3.00/MF $0.65

The periodic position and velocity perturbations of an artificial earth satellite are developed to the first order for all Jn, based on the theory by Brouwer as extended by Giacaglia. An explicit formulation is also provided for the subset J2, J3, J4. The use of a position and velocity formulation circumvents the equatorial and circular orbit singularities found in conventional developments. The definition of the mean elements of the theory is modified to reduce the complexity of the position perturbations, as suggested by Mersons Theory, and the resulting changes to the secular terms are developed. In order to facilitate an empirical correction for drag, the observed mean motion is introduced as a mean element in place of the semi-major axis. Author (TAB)

N67-27517*# Volt Technical Corp., Washington, D. C.
NOMOGRAM FOR THE DETERMINATION OF THE LIFETIME OF AN ARTIFICIAL EARTH'S SATELLITE [NOMOGRAMMA DLYA OPREDELENIYA VREMENI SUSHCHESTVOVANIYA ISZ]
Yu. S. Vlasov 10 May 1967 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, 1967 p 200–204
(Contract NAS5-12487)
(NASA-CR-84465; ST-CM-AI-10601) CFSTI: $3.00 CSCL 22A

A graphic method is substantiated for an approximate evaluation of the lifetime of an artificial earth satellite (AES) taking into account the density variation of upper atmosphere layers in the course of the solar activity cycle. The nomogram proposed for the determination of an AES lifetime by this method is based upon known data on atmosphere density. Author

N67-27527*# International Information, Inc., Philadelphia, Pa.
PLANE EVOLUTION OF A SATELLITE'S ELLIPTICAL ORBIT UNDER THE INFLUENCE OF A LATERAL DISTURBING FORCE [EVOLYUTSIYA PLOSKOSTI ELLIPTICHESKOY ORBITY SPUTNIKA POD VLIYANIYEM BOKOVOY VOZMUSHCHAYUSHCHEY SILY]
Yu. M. Kopnin Mar. 1967 4 p Transl. into ENGLISH from Inzh. Zh. (USSR), no. 6, 1966 p 36–37
(Contract NASw-1499)
(NASA-TT-F-10740) CSCL 22C

An investigation is made of satellite motion as a mass point under the influence of disturbing acceleration, constant in modulus and directed normal to the osculating orbital plane. The shape of the orbit is always constant and the problem is reduced to a study of a system of three equations defining the precession of the orbital plane. Author

N67-27560# Hungarian Academy of Sciences, Budapest.
PHOTOELECTRIC OBSERVATIONS OF NOVA HER 1963
I. Almar and E. Illes-Almar 1966 25 p refs
(Rept.-60)

Nova Herculis 1963, discovered on Feb. 6, 1963 by E. Dahlgren, was observed photoelectrically in three colors from Feb. 9, 1963 to Oct. 2, 1964 at the Konkoly Observatory. Magnitudes, reduced to a single comparison star and one photometric system, were compared with other photoelectric observations taken from the literature. The plotting of a composite light curve proved to be possible, at least in the first three months. Rapid fluctuations in brightness and color were already suspected in 1964 and confirmed later by photoelectric observations at the Asiago Observatory. Breaks discovered on the color-index and on the logarithmic light curves were confronted with spectroscopic results. Author

N67-27579*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A METHOD OF CALCULATING INTERPLANETARY TRAJECTORIES
Robert C. Blanchard and H. Wolf (Anal. Mech. Assoc.) May 1967 64 p refs
(Contract NAS5-9298)
(NASA-TM-X-55792; X-643-67-198) CSCL 22C

This report presents equations and Fortran program listings for generating approximate patched-conic interplanetary trajectories. The universal form of the conic equations is used for coasting arcs with the universal anomaly, β, as the independent parameter. A pseudo-burn approximation is used for the powered portions of the flight. A selection of terminating conditions for the coasting arcs are presented and discussed. Planet ephemerides are calculated from prestored constants of their motion. Author

N67-27580* Boeing Co., Seattle, Wash. Aerospace Group.
LUNAR ORBITER I. VOLUME VI: APPENDICES Final Report
28 Mar. 1967 259 p
(Contract NAS1-3800)
(NASA-CR-66333) CSCL 22A

The purpose of this appendix is to provide the reader with a method by which the 211 photographs taken of the lunar surface can be identified with respect to readout periods and with respect to actual photo sites on the lunar surface. The lunar photographs appear in the form of (1) 35-mm film (which is the output of the GRE at each DSIF site), and (2) 9-1/2-inch film (which is the output of the reassembly printer at Eastman Kodak). Separate numbers were assigned during the mission for each readout sequence from the spacecraft. Prior to the flight, edge data numbers were pre-exposed on the spacecraft film. These edge print numbers or frameiet numbers are the key to finding a specific frameiet read out from the spacecraft within any given photograph or subframe. Each readout sequence from the spacecraft was recorded at a specific DSIF site. The table will include the makeup of the individual reassembled subframes with respect to edge print numbers from the primary GRE roll. Author

N67-27629# Specola Vaticana (Vatican City).
ORIGIN AND EVOLUTION OF THE PHYSICAL WORLD [ORIGINE ED EVOLUZIONE DEL MONDO FISICO]
Patrick J. Treanor 1966 32 p refs In ITALIAN *Its* Communicazione No. 32

The origin of the universe in general, and the earth in particular is discussed in general philosophical terms. Brief details are presented on the physical structure of the universe, the galaxies, and the galactic system. Theoretical models of the Earth are mentioned, and the possibility of life on other planets theorized. Transl. by R.Ll.

N67-27634 Royal Aircraft Establishment, Farnborough (England).
THE VARIATION OF AIR DENSITY AT A HEIGHT OF 220 KM IN THE FIRST HALF OF 1966

D. G. King-Hele and Eileen Quinn Nov. 1966 11 p refs
(RAE-TR-66350)

The changes in the orbit of the satellite Star-rad (1962 $\beta\kappa$) between January and June 1966 are analysed to determine the variation in upper-atmosphere density at a standard height (220 km) a little above the satellite's perigee height. It is found that the air density in May–June was about 30% greater than in January–February, as a result of the increase in solar activity. The fluctuations in density on a shorter time-scale, 2 to 3 days, are also shown. Author

N67-27641*# Analytical Mechanics Associates, Westbury, N. Y.
A TREATMENT OF THE μ-BIAS Interim Report
Samuel Pines, Henry Wolf, and Ann Bailie Mar. 1967 16 p
(Contract NAS5-9085)
(NASA-CR-84483; Rept.-67-7) CFSTI: HC $3.00 CSCL 22C

Consideration is given to the uncertainty of the earth's gravitational constant which leads to earth model errors in obtaining orbit determination schemes. The treatment of this uncertainty uses the gravitational constant as an additional state variable without necessitating its redetermination or the re-evaluation of its variance. C.T.C.

N67-27642*# Analytical Mechanics Associates, Westbury, N. Y.
A SET OF UNIFORM VARIATIONAL PARAMETERS FOR SPACE TRAJECTORY ANALYSIS
Samuel Pines, Henry Wolf, and Ann Bailie Feb. 1967 38 p refs
(Contract NAS5-9085)
(NASA-CR-84484; Rept.-67-5) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A set of orbit parameters (α_1, α_2, α_3, α_4, α_5, α_6) is presented which may be used in differential correction schemes. This set of parameters contains the energy (more precisely 1/a), all others being independent of the energy. Consequently, the set of parameters, does not exhibit the deterioration in the conditioning of the associated matrices, such as is shown if the initial state vector, for instance, is used. In addition the set is almost completely general allowing for continuous transition from circular to elliptic, and from elliptic to parabolic and hyperbolic orbits. No special measures need be taken for equatorial or near equatorial orbit planes. The positioning of the orbit plane is achieved by means of rigid rotations of this plane about the velocity and position vectors of the nominal orbit. The orbit in its plane is positioned by a rigid rotation about the nominal angular momentum vector. Thus on the nominal orbit the α_1, α_2, and α_3 are identically zero. The remaining α's are quantities associated with the size and shape of the orbit. For many problems it is convenient to treat the gravitational constant, μ, as an additional variable, and this report contains the analytic partial derivatives for the seventh parameter. In addition, the differential state transformation matrix is augmented to a full seven by seven to accommodate this new variable. Author

N67-27647*# IIT Research Inst., Chicago, Ill. Astro Sciences Center.
SCIENTIFIC OBJECTIVES OF DEEP SPACE INVESTIGATIONS: JUPITER AS AN OBJECT OF BIOLOGICAL INTEREST
May 1967 37 p refs
(Contract NASr-65(06))
(NASA-CR-84492; IITRI-P-19) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The report discusses the Jovian environment; some of the biological systems that conceivably could evolve under such conditions; current ideas about the origin of terrestrial life; an assessment of the importance of Jupiter from a biological point of view; and, the effect of this information on the planning of conventional observations and spacecraft missions to the planet for purposes of scientific exploration. It is concluded that presently available evidence justifies a biological exploration of Jupiter with early emphasis on the atmosphere below the clouds. Author

N67-27700# Royal Observatory, Edinburgh (Scotland).
GROUP CORRECTIONS AND THE OPTIMIZATION OF AN OBSERVING PROGRAMME
D. V. Thomas London, HMSO, 1967 29 p refs *Its* Bull.-127
HMSO: 4s

Methods of determining group corrections are discussed. Using the chain method, formulas are derived relating the precision of the group corrections to the number of groups and stars. The efficiencies for the determination of mean values of the directly observed quantities, catalog corrections, and astronomical constants are expressed in terms of the parameters describing the organization of the program. The most critical factor is the number of groups, which must be reduced to a minimum. This operates against observatories at high latitudes. The establishment of a series of PZTs or astrolabes in suitable equatorial sites would lead to a significant improvement in our knowledge of the rotation of the earth. The choice between a continuous observation near midnight with the chain method of analysis, and the observation of separate evening and morning groups with the supergroup method of analysis, depends on the particular circumstances of each individual program. Formulas are derived for the precision of important functions of the group corrections. A note is included on the weights of partly-dependent group differences. Author

N67-27741*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY 37-44, VOLUME VI FOR THE PERIOD JANUARY 1, 1967 TO FEBRUARY 28, 1967. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
31 Mar. 1967 35 p
(Contract NAS7-100)
(NASA-CR-84519; JPL-SPS-37-44, Vol. VI) CFSTI: HC $3.00/MF $0.65 CSCL 22A

CONTENTS:

1. SURVEYOR PROJECT p 1–4 (See N67-27742 14-31)
2. MARINER VENUS 67 PROJECT p 5–7 (See N67-27743 14-31)
3. MARINER MARS 1969 PROJECT p 8–15 (See N67-27744 14-31)
4. DSN CAPABILITIES AND FACILITIES p 17–18 (See N67-27745 14-11)
5. DSIF DEVELOPMENT AND OPERATIONS p 19–23 (See N67-27746 14-11)

N67-27762# Bölkow Entwicklungen K. G., Munich (West Germany).
ON THE SELECTION AND EVALUATION OF PROJECTS FOR A SPACE FLIGHT PROGRAM [ZUR AUSWAHL UND BEWERTUNG VON PROJEKTEN FUER EIN RAUMFLUGPROGRAMM]
D. E. Koelle 6 Sep. 1966 21 p In GERMAN
(RF-720)

Purpose of the study is to investigate methods and means for evaluating single space flight projects against the background of long range national planning of space exploration. The German national planning is critically compared with the programs of France and NASA. Discussed are organization of ground facilities, working groups, and timing of program phases. Criteria for program selection are stated, and program costs are considered. Two examples are presented of 12-year models in which programs are weighted and analyzed for costs. Transl. by K.W.

N67-27780# Uppsala Univ. (Sweden).
A STUDY OF GALACTIC STRUCTURE IN CASSIOPEIA
Tarmo Oja 1966 7 p refs
CFSTI: HC $3.00/MF $0.65

The calibration of intrinsic colors and absolute magnitudes of stars as a function of certain spectral classification criteria, is noted. Methods of determining the intrinsic colors and absolute magnitudes from the spectrophotometric criteria were applied to a large number of stars located in the Milky Way in Cassiopeia to study the space distribution of interstellar absorbing matter and of stars. Spectrophotometric data and the proper motions for more than 2500 stars in the region studied are given. Two open clusters, M 103 (=NGC 581) and Tr 1 in the region were also investigated. L.S.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N67-28481 Royal Aircraft Establishment, Farnborough (England).
THE FLIGHT OF VENUS 2 AND 3
27 Apr. 1966 15 p Transl. into ENGLISH from Pravda (Moscow), 1 Jan., 2, 6, Mar. 1966
(RAE-LIB-PRESS-TRANS-97)

Journalistic reports are given of the flights of Venus 2 and 3. Consideration is given to the spacecraft configuration, telemetry, trajectory, scientific instrumentation, and data processing. L.E.W.

N67-28482 Royal Aircraft Establishment, Farnborough (England).
THE FLIGHTS OF COSMOS 120, 121 AND 122
6 Jul. 1966 3 p Transl. into ENGLISH from Pravda (Moscow), 9, 18, 26 Jun. 1966
(RAE-LIB-PRESS-TRANS-106)

Extracts from journalistic reports are presented. Orbital elements, and the transmitter, radio system, and telemetry are mentioned. N.E.N.

N67-28531*# Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.
THE TWO-PLANET FLYBY PROBLEM
Ronald Eng Young *In its* Rev. of NASA Sponsored Res. at the Exptl. Astronomy Lab. Jan. 1967 p 65–70 ref (See N67-26521 14-21)

Impulsive patched-conic trajectories flying by Venus and Mars are considered. The two-planet or double flybys are a version of the interplanetary grand tour departing Earth, passing by Mars and Venus once each without stopover, and returning to Earth. The launched vehicle's heliocentric transfers were determined by solving Lambert's problem. At the flyby planets, the required thrust for the turn was computed as the velocity difference between the inbound and outbound hyperbolae at the common peripont. In the case of pure double flybys, for which no thrust is applied at the flyby planets, two of the four planet dates became dependent variables. A computer program was created to select Venus and Mars flyby dates by iterating the velocity differences to zero. The program was used to search for pure double flybys during other Mars oppositions in the 1970's and 1980's. A search algorithm was finally evolved to determine the Mars and Venus flyby dates for specified launch and arrival dates. It was found that time-sharing techniques were used to good advantage in developing a fruitful method for obtaining profiles of the pure double flyby mission. R.Li.

N67-28547*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SLOSH DYNAMICS STUDY IN NEAR ZERO GRAVITY—DESCRIPTION OF VEHICLE AND SPACECRAFT
Harold Gold, Jack G. McArdle, and Donald A. Petrash Washington, NASA, May 1967 28 p refs
(NASA-TN-D-3985) CFSTI: HC $3.00/MF $0.65 CSCL 22D

A spacecraft carrying a 22-inch-diameter, 44-inch-long transparent tank equipped with a slosh baffle and partially filled with alcohol was flown into a ballistic trajectory by the two-stage WASP (weightlessness analysis sounding probe) rocket. In free flight the spacecraft was rate-stabilized by a proportional gas jet system. Thrusts were provided that established 6.5×10^{-3}- and 7.3×10^{-4}g acceleration along the longitudinal axis of the tank and a lateral acceleration of 7×10^{-3} g for periods of a few seconds (to induce sloshing of the alcohol within the tank). The spacecraft carried a television system for observation of the alcohol motion. The damping induced by the slosh baffle was sufficient to damp slosh in less than one-quarter cycle at both longitudinal accelerations. The performance of the WASP vehicle, which provided a period of over 6 minutes of flight above an altitude of 250,000 feet for the 1528-pound payload, was very close to design values on its first flight test. Author

N67-28581*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1964 TEMPERATURE CONTROL HARDWARE DESIGN AND DEVELOPMENT
W. Carroll, G. G. Coyle, and H. Von Delden 1 Jun. 1967 30 p refs
(Contract NAS7-100)
(NASA-CR-84293; JPL-TR-32-955) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The temperature control system on the Mariner Mars 1964 spacecraft, including both passive and active controls, is described. Passive controls comprised (1) special surfaces and finishes, and (2) thermal shields; active controls were thermostatically actuated louvers. The evolution of the design is traced from inception to final configuration, including design criteria and fabrication techniques. The criteria for selecting surface finishes and materials are discussed in relation to spacecraft requirements and space-simulator testing conditions. Recommendations are made that may be applicable to the design of temperature control hardware for future projects. Author

N67-28585*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A "HUMMINGBIRD" FOR THE L_2 LUNAR LIBRATION POINT
F. O. Vonbun Apr. 1967 22 p refs
(NASA-TM-X-55778; X-507-67-167) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Consider as an example a spacecraft, contrary to all previously published investigations, not in an orbit but in a more or less permanent position in the vicinity of the far-sided lunar libration point L_2, as commonly called. Such a spacecraft would be very useful for a communications relay between the back side of the moon and an earth tracking station. It could be placed "above" the lunar libration point in such a fashion that it is never occulted, thus making the stated communication link a continuous one, independent of time. Obviously, the spacecraft will be in an accelerating force field and thus will need a permanent thrusting to "stay" in place, or move slowly around a predetermined point in space similar to a "Humming Bird." The purpose of this report is to show, in simple analytical form, what the accelerations are in the vicinity of L_2 and what specific impulse values are needed to keep a spacecraft there economically, that is, with a reasonable fuel to useful spacecraft mass ratio (m_f/m_o=0.05 to 0.15). Author

N67-26591*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GROUNDING OF ROCKET EXPERIMENTS
Gary D. Harris Feb. 1967 14 p
(NASA-TM-X-55768; X-614-67-42) CFSTI: HC $3.00/MF $0.65 CSCL 22D

An assessment is made of the points to be considered in designing and constructing an experiment so as to make it compatible with, and immune to the noise from, the rocket and pointing control on which it is flown. The problems encountered in grounding an amplifier circuit are discussed in relation to the ways that noise can be introduced into the amplifier. The grounding system used on the Aerobee rockets is described and depicted. Flight tests showed that the noise on the signal lines was well within the limits of the telemetry and recording devices used on the flight. M.G.J.

N67-26592*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AIMP (IMP-D) TECHNICAL SUMMARY DESCRIPTION
Mar. 1967 98 p
(NASA-TM-X-55770; X-724-67-87) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A functional description is presented on the structure, experiments, telemetry, power system, and instrumentation of the AIMP-D spacecraft (Explorer XXXIII). Such structural design features as thermal balance, electrical restraints, stability requirements, modular concept, accessibility for rework and/or replacement, nonmagnetic hardware, and high strength to weight ratio are discussed. The purpose, theory of operation, and telemetry used for the seven active experiments carried aboard the spacecraft are also described. These included ionizing radiation, thermal ion electron, energetic particle, plasma probe, and solar cell damage experiments. Two magnetometer experiments were designed to measure the magnitude, direction, and spatial and temporal variations of the magnetic field in interplanetary space as the spacecraft orbits the moon, and to yield the precise vector magnetic field data from the spin-stabilized spacecraft. M.G.J.

N67-26593*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYSIS OF TRANSPORTATION SYSTEMS FOR SPACE STATION LOGISTICS
R. E. Valentine 6 Apr. 1967 83 p refs
(NASA-TM-X-53594) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This report presents the results of an investigation to determine which launch vehicles NASA will need in the post-Apollo Applications Program (AAP) period. The results given do not settle the question, because this is impossible until better mission definitions are available for that period. This report, however, presents data which indicate the important mission parameters and the sensitivities of vehicle systems to changes in these parameters. These data will prove valuable as requirements are better defined and the need for decisions become critical. The report describes the launch vehicles and spacecraft considered in the study, defines the missions for which the systems would be used, describes the analysis methodology, and presents conclusions and observations based on the results. Author

N67-26600*# National Aeronautics and Space Administration, Washington, D. C.
COMMUNICATIONS SATELLITES
May 1967 96 p refs
(NASA-SP-7004(03)) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The contents include references to such topics as television broadcasting, telemetry, outer-space systems, multi-station systems, and medium-height, random-orbit systems. The economic and legal implications of communications satellite systems are represented. References are also included which describe the history and operation of individual satellites such as Advent, Courier, Echo, Relay, Score, Syncom, and Telstar, as well as several satellites used for meteorological studies. Each entry in the bibliography consists of a citation and an abstract. A subject index and a personal author index are included. These indexes use the notation of content (NOC), a one-sentence description of the contents of a document, rather than the title to aid the user in locating pertinent entries. Author

N67-26635*# Brown Engineering Co., Inc., Huntsville, Ala.
RETRIEVABLE MARS PROBE DEFINITION
Felix Godwin 17 May 1967 157 p
(Contract NAS8-20073)
(NASA-CR-61172) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A study was carried out on the possibilities of using an automatic probe to obtain a small sample of Martian soil. The probe is launched during a manned flyby mission; it descends to the planetary surface, collects a soil sample, and ascends to rendezvous with the spacecraft. Author

N67-26819# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THERMAL DESIGN OF CURRENT NAVIGATIONAL SATELLITES
S. E. Willis, Jr. Oct. 1966 41 p ref
(Contract NOw-62-0604-c)
(APL-TG-845; AD-648307) CFSTI: HC $3.00/MF $0.65

In recent years Navy Navigational Satellites in orbit have been operating at temperatures some 20 to 30F hotter than was predicted by preflight tests and calculations. As a consequence, an exhaustive analysis of the thermal design was conducted, followed by a very extensive thermal vacuum testing program. This testing program verified most of the analysis and supplied solutions to problems that could not be answered in the analysis. In the final design, low thermal resistances were used between inside components and the satellite exterior. Large amounts of thermal control power were dissipated on the internal components in order to maintain a nearly constant temperature. As a result of the new design, derived from the analysis and testing, the difference between orbital results and preflight calculations was reduced to 2 - 3F. Author (TAB)

N67-26879# Northrop Space Labs., Hawthorne, Calif.
PHASE I ANALYSIS OF DATA RETURNED BY THE FESS EXPERIMENT FROM THE OVI-2 SPACECRAFT, OCTOBER 1965–AUGUST 1966
M. C. Chapman Kirtland AFB, N. Mex. AF Weapons Labs., Mar. 1967 110 p refs
(Contract AF 29(601)-7038)
(AFWL-TR-66-94; AD-648719) CFSTI: HC $3.00/MF $0.65

Automatic data processing techniques developed for reduction of data returned by the Flight Experiment Shielding Satellite (FESS) experiment from the OV1-2 spacecraft are presented. Computer programs are discussed which accept data from digital magnetic tapes, remove instrument calibrations and temperature effects, organize and list the data, and electronically plot selected parameters. Experiment performance is reviewed; all instruments have operated in excess of nine months in orbit. Proton and electron spectrums are presented, and significant differences from the Vette grids are found for some regions of space. Results of theoretical dose calculations using Vette grids and experimental FESS particle data are presented, and are compared with measured doses in the spacecraft, and influencing factors are discussed. Unidirectional flux grids in B, L space for typical L-shells are presented. General recommendations are presented for further analyses of the data, taking into consideration the generally poor quality of the digital data tapes available for processing. Author (TAB)

N67-27221*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

DEFINITION OF SPACECRAFT AND RADIATOR INTERRELATIONS FOR NUCLEAR RANKINE SYSTEMS

R. D. Cockfield 26 Jan. 1967 133 p refs

(Contract NASw-1449)

(NASA-CR-72245; GE-ANSO-6300-166) CSCL 22B

The three tasks covered in this report are: (1) definition of spacecraft and radiator interrelations; (2) comparison of load bearing and non-load-bearing radiators; and (3) comparison of direct condensing and indirect radiators. Investigated are geometry, loading, and system interactions between large radiators for space nuclear systems and their launch vehicles, including extension of the radiator over the final propulsion stage. Limitations to radiator areas are defined, and parametric data on loads and radiation shielding weights are generated. Weights are appropriate to unmanned missions only. Launch loads are evaluated for the Saturn IB and the two-stage and three-stage versions of the Saturn V. The launch loads acting at the payload interface are determined as a function of radiator size and payload weight. The feasibility of utilizing the upper stages for additional radiator area is investigated. A parametric study of nuclear radiation shielding is included for both conical and flat panel-radiator configurations. An evaluation of the effect of launch loads on the optimization of radiator design is included. K.W.

N67-27235*# National Aeronautics and Space Administration, Washington, D. C.

FIFTH IMP MOST COMPLEX IN SERIES

19 May 1967 14 p

(NASA News Release-67-121) Available from the Scientific and Technical Information Division CSCL 22B

This press release was issued on the occasion of the launching of the fifth Interplanetary Monitoring Platform-F (IMP-F). Mission of the spacecraft, background data, instrumentation, telemetry, power supply, and functions of experiments are summarized. Statistics of the three-stage improved Delta launch vehicle are given. Briefly presented are orbital data and a review of the accomplishments of previous IMP satellites. A summary of program management is included. K.W.

N67-27270*# Aeronutronic, Newport Beach, Calif.

THE EFFECT OF EDGE CONSTRAINT ON THE BUCKLING OF SANDWICH AND RING-STIFFENED 120 DEGREE CONICAL SHELLS SUBJECTED TO EXTERNAL PRESSURE

Gerald A. Cohen Washington, NASA, May 1967 27 p refs

(Contract NAS1-5554)

(NASA-CR-795) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The buckling strength of a 120° truncated conical shell, with dimensions typical of a planetary entry body, subjected to a uniform external pressure reacted at the small edge was studied using Novozhilov shell and ring theory. Five cases of ring-stiffeners at the large end (with a prescribed ring at the small edge) and simply supported edges were treated for each of the following two wall constructions. (1) an aluminum sandwich and (2) a magnesium monocoque with many equally spaced interior rings. For each wall construction the minimum base ring size (of a one-parameter family of rings) required to effectively produce complete edge constraint is determined. Author

N67-27284*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPARISON OF THE AGENA/MARINER-C AND AGENA/LUNAR ORBITER SHROUD AERODYNAMIC CHARACTERISTICS FOR THE MACH NUMBER RANGE FROM 0.56 TO 3.46

Bobby Sanders Washington, NASA, 1967 102 p ref

(NASA-TM-X-52298) CFSTI: HC $3.00/MF $0.65 CSCL 22B

An investigation was conducted to compare the Agena/Mariner-C and Agena/Lunar Orbiter shroud aerodynamic characteristics. Models of the two test vehicles were tested in the Lewis 8×6 foot and 10×10 foot wind tunnels over the Mach number range from 0.56 to 3.46. Force measurements indicate a negligible change in normal force and moment coefficients for angles of attack and yaw below 8°. Axial forces for the Agena/Lunar Orbiter were larger for each of the test Mach numbers with the maximum increase at Mach 1.0. Static pressure distributions that are presented for the Agena/Lunar Orbiter show a sharp increase in static pressure axially along the shroud vent door for Mach 0.90. This sharp change in static pressure is caused by an overexpansion downstream of the shroud shoulder which is terminated by a shock wave at the vent door location. Author

N67-27308*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

GALACTIC JUPITER PROBES

J. F. Clark, E. W. Hymowitz, and J. H. Trainor Mar. 1967 16 p refs

(NASA-TM-X-55785; X-100-67-211) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The feasibility of a galactic Jupiter probe, which involves a spacecraft launched at 13-month intervals beginning in 1972, is discussed. Early spacecraft in the series would probably weigh nearly 500 pounds. Each mission would be a flight through the asteroid belt and a flyby of the planet Jupiter. Beyond this point at least five separate missions, each using the gravitational assistance of a flyby, are proposed. A possible first mission, a deep space trajectory in the plane of the ecliptic, is described. The following design areas related to this mission are examined: system reliability, thermal design, meteoroid protection, radioisotope thermoelectric generator created radiation environment, stored data, and communications. S.P.

N67-27316*# National Aeronautics and Space Administration, Washington, D. C.

MARINER/VENUS SET FOR JUNE LAUNCH AT CAPE

4 June 1967 58 p

(NASA News Release-67-124) Available from the Scientific and Technical Information Div. CSCL 22B

The Mariner Venus 1967 mission to obtain scientific data on the origin and nature of Venus is described. An Atlas–Agena D vehicle will launch the Mariner Venus spacecraft. The interplanetary science payload will include instruments similar to those carried to Mars by Mariner IV. A solar plasma probe, a trapped radiation detector, and a helium vapor magnetometer will report on radiation and magnetic fields from Earth to Venus and beyond. The close approach of Mariner to Venus will have a radical effect on the spacecraft's orbit which, after flyby, will bring it closer to the Sun than any previous mission. Background information pertaining to such items as the spacecraft configuration, scientific investigations, the Atlas–Agena D launch vehicle, the trajectory, tracking and data acquisition, and the Mariner Venus 1967 team are also included. S.P.

N67-27416*# National Aeronautics and Space Administration, Washington, D. C.

SATURN V, MANNED FLIGHT TO THE MOON

[1967] 8 p

(NASA Facts, Vol. IV, No. 5; NASA Facts-NF-33) GPO: HC $0.25; CFSTI: MF $0.65 CSCL 22D

As part of NASA's educational program, a pictorial fact sheet is presented on the Saturn V. Summary data are included on the physical and performance characteristics of the three stages; the instrument unit; and the command, service, and lunar modules of the Apollo spacecraft. M.G.J.

N67-27419*# Boeing Co., Seattle, Wash. Aerospace Group.
LUNAR ORBITER MISSION I. VOLUME III: MISSION OPERATIONAL PERFORMANCE Final Report
3 Feb. 1967 443 p
(Contract NAS1-3800)
(NASA-CR-66324; D2-100727-3) CFSTI: $3.00 CSCL 22B

A functional description is presented on the Lunar Orbiter 1, which provided a stable and controllable platform from which to take pictures, and which contained instrumentation to sample certain lunar environmental conditions and to determine the performance of the spacecraft subsystems while operating in the cislunar and lunar environments. Results are included on the performance analysis of the systems employed to command and control the mission and to recover the desired data. The combined launch vehicle configuration is depicted; this consisted of an Atlas SLV-3 primary booster for earth orbit placement, and an Agena D upper stage booster for achieving the proper cislunar trajectory. Performance data are provided. The launch operations plan is discussed, with details given on prelaunch organization, launch base facilities, spacecraft processing, and countdown and launch criteria and constraints. Flight operation procedures and scheduling are also discussed in relation to mission control, operational organization, the Deep Space Network, and mission conduct. M.G.J.

N67-27608*# National Aeronautics and Space Administration, Washington, D. C.
THE EOLE WEATHER SATELLITE [LA SATELLITE METEOROLOGIQUE EOLE]
Pierre Morel Jun. 1967 10 p Transl. into ENGLISH from Rech. Spatiale (France), v. 6, no. 3, Mar. 1967 p 4–8
(NASA-TT-F-10984) CSCL 22B

The Eole experiment, which involves the use of a special meteorological satellite for following the movement of point tracers on a worldwide scale is discussed. Background data consisting of conditions for planetary weather forecasting are presented. The shortcomings of worldwide ground stations are first, that they are not dense enough outside the inhabited and developed regions of North America, Europe, Russia, and Australia; and second, that the measurements obtained at the existing stations do not enable prescription of air movements in the tropical regions with sufficient precision. Atmospheric tracers in the Eole experiment consist of point tracers, or ceiling balloons, equipped with a radioelectronic responder. These balloons also carry weather instruments whose measurements will be picked up at the same time, during each passage of the satellite. The basic principle behind the ceiling balloon is described, and the problem of its mechanical strength is examined. Since the Eole satellite is projected for 1969, a radioelectric beacon, which operates like an automatic sextant constantly measuring the height of the sun above the horizon of the balloon, is being used provisionally. The first flights of ceiling balloons at an altitude of 9000 m are illustrated. S.P.

N67-27620*# Astro Research Corp., Santa Barbara, Calif.
THE FEASIBILITY OF AN ORBITING 1500-METER RADIOTELESCOPE
William M. Robbins, Jr. Washington, NASA, Jun. 1967 23 p refs
(Contract NAS7-426)
(NASA-CR-792) CFSTI: $3.00 CSCL 22A

The development of an orbiting, 1500-meter radiotelescope is reviewed. The radiotelescope system utilizes a paraboloidal reflector formed by a network of aluminum ribbons and weighs only about 1300 kg in orbit. The fabrication, deployment, control, and long-term survival of such a system appear entirely feasible. Author

N67-27627* Astro Research Corp., Santa Barbara, Calif.
THE HELIOGYRO: AN INTERPLANETARY FLYING MACHINE
Richard H. MacNeal 13 Mar. 1967 73 p refs
(Contract NAS7-427)
(NASA-CR-84460; ARC-R-249) CSCL 22B

A design concept is developed for a type of solar sail vehicle that employs long, narrow blades made from thin films and that operates in the manner of a helicopter rotor. The blades are unrolled from spools during deployment. Three different versions of the heliogyro are described, including a small experimental two-blader, and two 100,000 pound gross-weight multi-bladed vehicles that are suitable for manned voyages to the inner planets. Some of the engineering problems associated with structural design and operation are treated, including consideration of static blade deformations, control characteristics, deployment, and maneuvers in planetary orbit. The performance of the heliogyro is discussed for a variety of missions including station keeping, station visiting, interplanetary travel and descent into planetary orbit. Author

N67-27652*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
PRELIMINARY TECHNICAL DATA FOR EARTH ORBITING SPACE STATION. VOLUME IV: CONFIGURATION, INTEGRATION AND WEIGHTS
7 Nov. 1966 172 p
(NASA-TM-X-59701; MSC-EA-R-66-1, Vol. IV) CSCL 22A

Technical data are presented on the configurations, integration, and weights of an Earth Orbital Manned Space Station study. The data are concerned with orientation, stability, design integration, spacecraft concepts, and the associated weights. A comparison of the space station and Mars missions is included. C.T.C.

N67-27653*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
PRELIMINARY TECHNICAL DATA FOR EARTH ORBITING SPACE STATION. VOLUME II: STANDARDS AND CRITERIA
7 Nov. 1966 26 p refs
(NASA-TM-X-59700; MSC-EA-R-66-1, Vol. II) CSCL 22A

Standards and criteria technical data for an Earth Orbital Manned Space Station study are presented. These data are concerned with the human factors, environment, logistics, and crew operations. Included are studies on medical requirements, habitability, artificial gravity, and training and environmental operations. C.T.C.

N67-27654*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
PRELIMINARY TECHNICAL DATA FOR EARTH ORBITING SPACE STATION. VOLUME III: SYSTEMS
7 Nov. 1966 341 p refs
(NASA-TM-X-59699; MSC-EA-R-66-1, Vol. III) CSCL 22A

Systems technical data for an Earth Orbital Manned Space Station study are presented. Consideration is given to the electrical power system, the environmental control/life support system, instrumentation, communications, and cryogenic storage. A discussion of the system requirements for a Mars mission is included. C.T.C.

N67-27655*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
PRELIMINARY TECHNICAL DATA FOR EARTH ORBITING SPACE STATION. VOLUME I: SUMMARY REPORT
7 Nov. 1966 158 p
(NASA-TM-X-59698; MSC-EA-R-66-1, Vol. I) CSCL 22A

Technical data on the various systems and components requirements of an earth orbital manned space station are presented.

Areas covered include the space station configuration and systems applicable to any physical configuration, standards and criteria, human factors, environment, operations, electrical power, environmental control/life support, crew systems, guidance and control, communications and data management, instrumentation, cryogenic storage, reaction control, structures, integration, and weights. C.T.C.

N67-27659*# National Aeronautics and Space Administration, Washington, D. C.
THE FUTURE POTENTIALS OF NAVIGATION SATELLITES
Eugene Ehrlich 4 May 1967 22 p refs
(NASA-TM-X-59646) CSCL 22B

The Navigation Satellite of the 1970–1980 time period can be expected to be an entirely different spacecraft than the presently operational Navigation Satellites of the U.S. Navy. The present day Navigation Satellite is capable of providing only one function—position determination services for ships. The Navigation Satellite of the future will provide a number of services for ships, aircraft (including the supersonic transport) and other advanced types of intercontinental transportation vehicles, such as ground effect machines and hydrofoil boats. These services will be: craft-to-craft communications, passenger telephone service to shore from commercial ships and aircraft, voice and data transmissions between ship and aircraft company business offices and their craft anywhere in the world, high position accuracy to permit reductions in the aircraft separation standards and reduce mid air and ocean collisions, a reliable solar radiation warning for SST type aircraft, up to date weather and sea state reports to ships and aircraft for improved comfort of travel, and en route monitoring of specific aircraft subsystems (engine performance, wing stress, etc.) for relay to a ground station to detect malfunctions. Author

N67-27704*# Bellcomm, Inc., Washington, D. C.
TETHER MANAGEMENT CONSIDERATIONS FOR AAP-4
William W. Hough 13 Apr. 1967 22 p
(NASA-CR-84430; TM-67-1022-1) CFSTI: HC $3.00/MF $0.65
CSCL 22B

If tethered operation of the LM–ATM is included in the AAP-3/AAP-4 mission, a solution to the tether wrap-up problem must be found. Tether wrap-up occurs when the tethered system is gravity-gradient stabilized because, to maintain its sun oriented attitude, the LM–ATM must revolve once per orbit with respect to the tether. A possible method of tether management is to attach the tether to a boom that is extended from the LM–ATM. The boom is held normal to the orbital plane by the ATM–CMG control system, and is of sufficient length that the LM–ATM will clear the tether as it rotates. In this stable attitude, the tether tension is constant and causes a torque on the LM–ATM because it acts at a moment arm approximately equal to the boom length. Since the LM rotates with respect to the tether once each orbit, the torque about any LM axis is perfectly periodic and integrates to zero with time. Although the net requisite change in CMG angular momentum is zero after an orbit, the tether torque must always be countered by the CMG's. Therefore CMG capacity sets limits on the boom length. Author

N67-27742*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR PROJECT
In its Space Programs Sum. 37–44, Vol. VI 31 Mar. 1967 p 1–4 (See N67-27741 14-30)

Details are presented on systems and scientific instrumentation for the third, fourth, and fifth through seventh flight spacecrafts (SC-3,4,5–7) of the Surveyor project. Systems engineering, testing, and resulting modifications are outlined, and a study to determine the allowable touchdown velocities for a lunar liftoff and translation maneuver is reported. Solar thermal vacuum testing of the SC-3 spacecraft and its hardware is described. Auxiliary and main battery data, and propulsion system investigations using test firings are reported. The alpha scattering experiment hardware and surface sampler design and instrumentation are discussed. N.E.N.

N67-27743*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER VENUS 67 PROJECT
In its Space Programs Sum. 37–44, Vol. VI 31 Mar. 1967 p 5–7 (See N67-27741 14-30)

Continuing research on design, development, and testing equipment are briefly discussed. The completion of the major qualification testing of the M67-1 and the verification test of the M67-2 spacecrafts are reported. The temperature control reference assemblies and the solar cell transducers are mentioned. Space simulator tests to verify the temperature control subsystem and data processing system are described. Emphasis was placed on the attitude control subsystem problems of pitch gyro failure, loss of torque gain of jet vane actuators, and Canopus sensor sensitivity to magnetic fields. N.E.N.

N67-27744*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1969 PROJECT
In its Space Programs Sum. 37–44, Vol. VI 31 Mar. 1967 p 8–15 (See N67-27741 14-30)

Flight spacecraft configuration and design changes are reported. Details are presented on the mechanical configuration and spacecraft instrumentation. The temperature control and telemetry subsystem are covered, and the redesign of the Canopus sensor and gyro-control assembly design for attitude control are described. The scan platform components and performance are mentioned. The redesigned hydrazine reactor and the spontaneous catalyst engine are discussed, along with the functions of the solar panel boost dampers. N.E.N.

N67-27748 International Geophysical Year World Data Center A, Washington, D. C.
CATALOGUE OF DATA IN WORLD DATA CENTER A—ROCKETS AND SATELLITES, 1 JULY-31 DECEMBER 1966
Feb. 1967 28 p refs

The catalog contains summary tables of sounding rocket, earth satellite, and space probe launchings, flight characteristics, and experiments. Included also is a bibliography of reports and reprints on: orbits and trajectories; observation and tracking; instrumentation and data recovery; geodesy and gravity; atmospheric and ionospheric physics and composition; particles and corpuscular radiation; magnetic fields and electromagnetic radiation; astronomy; and biology. N.E.N.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N67-26491# Hayes International Corp., Birmingham, Ala.
DESIGN MANUAL FOR GROUND MOUNTED AIR-SUPPORTED STRUCTURES (SINGLE AND DOUBLE WALL)
A. E. Dietz, R. B. Proffitt, and R. S. Chabot Natick, Mass., Army Natick Labs., Oct. 1966 123 p refs
(Contract DA-19-129-AMC-129(N))
(TR-67-35-ME; AD-648645) CFSTI: HC $3.00/MF $0.65

The objective of this design manual is to provide industry and Government suppliers with design information to fabricate functional and reliable air-supported structures at the lowest possible

weight. The data and design information presented are based on wind tunnel tests and analytical determinations reported in another publication. Design information is given for spherical, cylindrical air-supported tents. The data in general are presented in nondimensional coefficient form and, therefore, are applicable to full scale structures within the range of parameters tested. Design information is presented as charts and tables on tent aerodynamic force and moment coefficient. Anchor and guideline coefficients, structural deflections, material stresses, packaged volume, and weight.
Author (TAB)

N67-26612# Illinois Univ., Urbana. Coll. of Engineering.
THEORETICAL AND APPLIED MECHANICS
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 183–194 refs (See N67-26601 14-34)

Certain theoretical and applied mechanics research programs are summarized for highly complex mathematical analyses of stresses, vibrations, fluid flow, or basic material behavior. Analytical and experimental aspects are briefly listed for such topics as deformation, fracture, dynamic loading, photoplasticity, aircraft metal fatigue, shelling of crane wheels, and creep prediction. Fluid dynamics and mechanics research topics are also briefly highlighted.
R.L.I.

N67-26630*# National Aeronautics and Space Administration, Washington, D. C.
PLANE PROBLEM OF THE MOMENT THEORY OF ELASTICITY FOR AN INFINITE PLANE WEAKENED BY A FINITE NUMBER OF CIRCULAR APERTURES [PLOSKAYA ZADACHA MOMENTNOY TEORII UPRUGOSTI DLYA BESKONECHNOY PLOSKOSTI, OSLABLENNOY KONECHNYM CHISLOM KRUGGOVYKH OTVERSTIY]
A. N. Guz, and G. N. Savin Mar. 1967 9 p refs Transl. into ENGLISH from *Prikl. Mat. i Mekh.* (Moscow), v. 30, no. 5, 1966 p 882–888
(NASA-TT-F-10789) CFSTI: HC$3.00/MF$0.65 CSCL 20K

An outline is presented of a method of solving plane problems of the moment theory of elasticity for a plane weakened by a finite number of arbitrarily located, circular, nontangential apertures. It is shown that these problems reduce to infinite systems of algebraic equations. The basic inequalities and relations required to prove the quasiregularity of the infinite systems and the uniqueness of the solutions are obtained. The case of two equal circular apertures is considered in detail.
Author

N67-26642# Naval Research Lab., Washington, D. C. Shock and Vibration Information Center.
THE SHOCK AND VIBRATION BULLETIN, NO. 36. PART 3: VIBRATION TESTING
Jan. 1967 175 p refs Presented at the 36th Symp. on Shock and Vibration, Los Angeles, 18–20 Oct. 1966
(AD-646982) CFSTI: HC$3.00/MF$0.65

CONTENTS:

1. USE OF FORCE AND ACCELERATION MEASUREMENTS IN SPECIFYING AND MONITORING LABORATORY VIBRATION TESTS G. W. Painter (Lockheed-Calif. Co.) p 1–13 refs (See N67-26643 14-32)

2. FEASIBILITY OF FORCE-CONTROLLED SPACECRAFT VIBRATION TESTING USING NOTCHED RANDOM TEST SPECTRA J. A. Heinrichs (Martin Co.) p 15–26 refs (See N67-26644 14-32)

3. COMPARISON OF MARINER ASSEMBLY-LEVEL AND SPACECRAFT-LEVEL VIBRATION TESTS T. H. Mack (JPL), P. A. Franken, and T. D. Scharton (Bolt, Beranek, and Newman, Inc.) p 27–38 refs (See N67-26645 14-32)

4. ACOUSTICALLY INDUCED VIBRATION TESTING OF SPACECRAFT COMPONENTS R. W. Peverley (GE) p 39–46 ref (See N67-26646 14-32)

5. REPRODUCTION OF COMPLEX AND RANDOM WAVEFORMS AT VARIOUS POINTS ON A TEST ITEM J. V. Otts and N. F. Hunter (Sandia Corp.) p 47–54 refs (See N67-26647 14-32)

6. MULTIPLE SHAKER GROUND VIBRATION TEST SYSTEM DESIGNED FOR XB-70A R. G. North and J. R. Stevenson (N. Am. Aviation, Inc.) p 55–70 refs (See N67-26648 14-11)

7. THE HOW OF HELICOPTER VIBRATION TESTING R. F. McCann (Boeing Co.) p 71–82 refs (See N67-26649 14-32)

8. RESONANCE TESTING OF A LIFTING BODY REENTRY VEHICLE G. Sardella and C. L. Riggen (Martin Co.) p 83–90 refs (See N67-26650 14-32)

9. SHOCK AND VIBRATION TESTING USING FOUR-SHAKER SYSTEM D. F. Redford (Thiokol Chemical Corp.) p 91–99 ref (See N67-26651 14-32)

10. DESIGN TECHNIQUES FOR HORIZONTAL DRIVERS F. C. Tolleth (Autonetics) p 101–112 refs (See N67-26652 14-11)

11. FLIGHT LEVEL VIBRATION TESTING OF A LIFTING BODY REENTRY VEHICLE R. McCaa and M. Matrullo (Martin Co.) p 113–118 (See N67-26653 14-32)

12. HYDRAULIC EXCITER COMBINED ENVIRONMENT TESTS E. J. Skolka (NASA, Goddard Space Flight Center) p 119–138 refs (See N67-26654 14-11)

13. AVERAGING FUNDAMENTAL VIBRATION CONTROL SIGNALS: A THEORETICAL STUDY W. W. Shurtleff (Sandia Corp.) p 139–146 refs (See N67-26655 14-32)

14. CONTROL TECHNIQUES FOR MULTI-SHAKER VIBRATION SYSTEMS R. A. Arone (Wyle Labs., Inc.) and P. A. Brock (Sine Engineering Co.) p 147–155 (See N67-26656 14-11)

N67-26643# Lockheed-California Co., Burbank.
USE OF FORCE AND ACCELERATION MEASUREMENTS IN SPECIFYING AND MONITORING LABORATORY VIBRATION TESTS
G. W. Painter *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 1–13 refs (See N67-26642 14-32)

Results are presented of a program devoted to the development of improved procedures for defining the vibration levels experienced by equipment attached to flight vehicles and providing realistic laboratory test levels. The program involved the measurement of the accelerations and forces experienced by simulated equipment attached to a vibrating aircraft fuselage. The equipment was later removed from the vehicle, placed on a shaker, and vibrated to a test specification based on an envelope of the acceleration peaks measured in the fuselage. Comparisions were then made of the acceleration levels that a resonant element in the equipment received in the fuselage and on the shaker. The tests on the shaker were repeated with the exception that, at those frequencies corresponding to an equipment resonance, the force transmitted to the equipment base was not allowed to exceed the maximum force developed (at any frequency) when the equipment was attached to the vibrating fuselage. It was found that this procedure largely eliminated the high levels of overtesting introduced by the conventional approach.
Author

N67-26644# Martin Co., Baltimore, Md.
FEASIBILITY OF FORCE-CONTROLLED SPACECRAFT VIBRATION TESTING USING NOTCHED RANDOM TEST SPECTRA
Joseph A. Heinrichs *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 15–26 refs (See N67-26642 14-32)

A summary of analyses and results is presented to substantiate the feasibility of using notched random test spectra for force-controlled spacecraft vibration tests. An analytical evaluation of structural loading at the base of the spacecraft caused by application of a broadband environmental acceleration spectrum is made. By using this analytical technique, notching requirements

for the broadband test spectrum are established which result in rms structural forces at the spacecraft base that are within the spacecraft's structural design load criteria. Structural loadings of other structural elements of the spacecraft and component acceleration spectra are examined on the basis of the notched spectra and are found to be within design values. The proposed method of notching is considered to be a feasible approach to force limiting when available booster driving force at the spacecraft-booster interface is not known. Author

N67-26645# Bolt, Beranek, and Newman, Inc., Van Nuys, Calif.
COMPARISON OF MARINER ASSEMBLY-LEVEL AND SPACECRAFT-LEVEL VIBRATION TESTS
Peter A. Franken, Terry D. Scharton, and Thomas H. Mack (JPL) *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 27–38 refs (See N67-26642 14-32)

Results are presented of a study of vibration data obtained in two series of tests of an electronic assembly from the Mariner C spacecraft. In one series of tests, the electronic assembly was mounted in a conventional vibration test fixture; in the other, the assembly was mounted in the spacecraft. The results of the study can be divided into two categories: those regarding the averaging of large collections of vibration data, and those concerning the differences between assembly-level and spacecraft-level vibration tests. Some recommendations are also given for future random vibration tests of aerospace structures. Author

N67-26646# General Electric Co., Houston, Tex.
ACOUSTICALLY INDUCED VIBRATION TESTING OF SPACECRAFT COMPONENTS
Richard W. Peverley *In* NRL Shock and Vibration Bull., No. 36, Pt 3 Jan. 1967 p 39–46 ref (See N67-26642 14-32)

Methods are described of acoustically inducing vibration structural segments to which components are attached. This technique has received very limited use on early programs. Recently, however, acoustically induced vibration testing was used extensively to qualify Apollo equipment. Approximately 70 components were tested on two distinct structural simulators. One simulator duplicated a segment of the Apollo Service Module radial beam. The acoustic spectrum was shaped to produce vibration levels which satisfied the vibration test criteria. The second simulator was a half section of a service module which was excited by acoustic energy duplicating the "worst case" flight environment. This test program provided an excellent simulation of predicted flight environments plus a reasonable margin of safety. A description of the use of acoustically induced vibration methods in a mission or space vehicle qualification program and a discussion of the advantages and shortcomings of the methods is also included. Author

N67-26647# Sandia Corp., Albuquerque, N. Mex.
REPRODUCTION OF COMPLEX AND RANDOM WAVEFORMS AT VARIOUS POINTS ON A TEST ITEM
John V. Otts and Norman F. Hunter *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 47–54 refs Sponsored by AEC (See N67-26642 14-32)

A technique is introduced whereby the Fourier series of any reference waveform can be reproduced at points on or below a test specimen. In addition, a compensation system is used to improve the low-frequency response. A fast sweep oscillator and a B&K response tracer allow equalization to be accomplished in hours as compared to days for earlier systems. The test setup, test procedure, and results are presented. Both a mechanical system and an electrical analog are used to illustrate the accuracy of this technique. This capability was developed to reproduce a test specimen's field vibration response in the laboratory. In these cases, the tape record serves as the reference signal. Specific areas of application include simulation of vibration experienced during lift-off of a rocket-payload system, simulation of vibration during ejection from an aircraft, and reproduction of the vibration-time history at the base of internal system components. Author

N67-26649# Boeing Co., Morton, Pa.
THE HOW OF HELICOPTER VIBRATION TESTING
Ronald F. McCann *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 71–82 refs (See N67-26642 14-32)

Vibration is an ever-present environment in helicopter flight. Ground vibration testing is an inexpensive method of reproducing vibratory motions induced by blade forces. The technique of ground shake testing started from inducing vibratory modes by means of many small exciters attached to fuselage locations with relatively simple instrumentation indicating in- or out-of-phase relationships of velocity pickups vs fuselage location for discrete frequencies. From this, it has evolved into relatively large exciter inputs at the rotor heads with considerable attention paid to instrumentation. With the aircraft suspended by steel springs, frequency sweeps are made from 6 to 20 cps and resonant points are located. Instrumentation allows direct X-Y plotting of phase and amplitude vs frequency with IBM card punch recording of shaker locations, input force, period of frequency, aircraft configuration, phase angle and amplitudes of displacement. Author

N67-26650# Martin Co., Baltimore, Md.
RESONANCE TESTING OF A LIFTING BODY REENTRY VEHICLE
G. Sardella and C. L. Riggen *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 83–90 refs (See N67-26642 14-32)

Resonance tests of the Martin SV-5D lifting reentry vehicle were conducted to substantiate experimentally the theoretical treatment used in the calculation of the vehicle vibration mode properties and to measure parameters which are too complex for theoretical treatment such as structural damping coefficient. Tests were conducted for configurations representing boundary conditions for the launch and reentry phases of flight. Tests were performed on a prototype vehicle which, except for the mass and inertia simulation of "black boxes," wiring and plumbing, consisted of the production flight article structure and ablative heat shield. The response of the vehicle under sinusoidal excitation was predicted by the matrix-force method to contain modes which were closely spaced in frequency and deflection patterns which were complex requiring three-dimensional representation. Typical three-dimensional mode shapes are presented for both of the configurations tested. Author

N67-26651# Thiokol Chemical Corp., Brigham City, Utah.
SHOCK AND VIBRATION TESTING USING FOUR-SHAKER SYSTEM
Dean F. Redford *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 91–99 ref Prepared for Douglas Missile and Space Systems Div. (See N67-26642 14-32)

A contract was awarded to test a LOX vent duct in three different environments: half-sine shock, swept frequency sine vibration, and random vibration. To accomplish test objectives, four-shaker systems were used in conjunction with a wave synthesizer, automatic sine wave vibration control units, and an automatic random vibration control unit. Use of the configuration described made it possible to conduct the test with a common spectrum supplied to the specimen from four outputs. Obviously, adding the specimen to the system changed the response characteristics of the fixture-loaded shaker system to some extent. Further, since three of the shakers did not have feedback amplitude control, the random spectrum varied from that of the unloaded system. The fourth shaker was held to specification by the automatic equalizer–analyzer. However, the nature of the specimen was such that the resulting spectrum change was within the ±3-db limit specified. Author

N67-26653# Martin Co., Baltimore, Md.
FLIGHT LEVEL VIBRATION TESTING OF A LIFTING BODY REENTRY VEHICLE
R. McCaa and M. Matrullo *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 113–118 (See N67-26642 14-32)

The vibration testing of spacecraft to the levels of the booster interface spectrum while supported by "rigid" fixtures is deemed unrealistic in that structural failures may be induced which would not occur on the more compliant support of the booster. Limiting of the shaker input forces at the vehicle support points to design limit loads precludes this type of failure. Random vibration tests conducted on the PRIME SV-5D lifting body utilized this force limiting approach and the techniques employed are described. Author

N67-26655# Sandia Corp., Albuquerque, N. Mex.
AVERAGING FUNDAMENTAL VIBRATION CONTROL SIGNALS: A THEORETICAL STUDY
W. W. Shurtleff *In* NRL Shock and Vibration Bull., No. 36, Pt. 3 Jan. 1967 p 139–146 refs Sponsored by AEC (See N67-26642 14-32)

A theoretical evaluation of three methods of vibration feedback control signal averaging is reported. The evaluation criteria employed are phase sensitivity, fundamental averaging, and accuracy and linearity of average. Experimental results confirm the theoretical superiority of the tracking filter and operational amplifier averaging technique over resistive and time-sharing averaging techniques. Author

N67-26676# IIT Research Inst., Chicago, Ill. Dept. of Mechanics.
ON PLASTIC INTERACTION CURVES
Philip G. Hodge, Jr. and Chang-Kuei Sun Feb. 1967 25 p refs
(Contract Nonr-140604)
(DOMIIT-1-34; AD-648384) CFSTI: HC $3.00/MF $0.65

A structure made of a rigid/perfectly plastic material and subjected to more than one independent load is considered. A mode vector is defined for any plastic mechanism and shown to have the same properties relative to the yield-point load interaction surface that the strain-rate vector has to the material yield surface. An application to a circular plate under two independent loads leads to close bounds on the interaction curve. Author (TAB)

N67-26739# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
ON LOCAL STABILITY OF FINITELY DEFORMED SOLID SUBJECTED TO FOLLOWER TYPE LOADS
S. Nemat-Nasser Mar. 1967 31 p refs
(Contract N0014-67-A-0109-0003)
(TR-7; AD-648997) CFSTI: HC $3.00/MF $0.65

The problem of the local stability (stability in the small) of a finitely deformed solid subjected to a set of follower type surface loads is analyzed, and a necessary, and a sufficient condition for asymptotic stability is established. Certain implications of the commonly used modal analysis are also investigated, and necessary and sufficient conditions for stability are formulated. Author (TAB)

N67-26814# Measurement Analysis Corp., Los Angeles, Calif.
CROSS-CORRELATION IN STRUCTURAL VIBRATION Final Technical Report
Pritchard H. White 31 Jul. 1966 102 p
(Contract N600(61533)-63705)
(MAC-508-02A; MEL-510/66; AD-648359)

The use of cross-correlation as a tool for analyzing vibration in complex structures was examined. Starting from basic principles, the equations governing propagation of waves and the cross-correlation of these waves were generated. Dispersive and non-dispersive waves in single and multipath systems were examined. Based upon the theoretical results, and confirmed by laboratory experiments, it appears that cross-correlation performed in one-third or one octave frequency bands is a useful tool for examining structural noise and vibration transmission. Under some circumstances shaping of the spectra is necessary to assure a flat cross spectrum over the frequency band of interest. Author (TAB)

N67-27015# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
ON ELASTIC, WORKHARDENING CIRCULAR PLATES
S. Nemat-Nasser Feb. 1967 12 p refs
(Contract N00014-67-A-0109-0003)
(TR-6; AD-648086) CFSTI: HC $3.00/MF $0.65

The rates of bending moments and curvatures which correspond to a given rate of loading from a given elastoplastic state of axisymmetrically loaded circular plate that consists of an elastic, workhardening material were obtained without postulating a priori a specific yield condition. Author (TAB)

N67-27061# Naval Research Lab., Washington, D. C. Shock and Vibration Information Center.
THE SHOCK AND VIBRATION BULLETIN NO. 36, PART 5
Jan. 1967 140 p refs Symp. on Shock and Vibrations, Los Angeles, 18–20 Oct. 1966
(AD-646983) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. METHOD FOR IMPROVING A DYNAMIC MODEL USING EXPERIMENTAL TRANSIENT RESPONSE DATA C.-u. Ip, E. P. Howard, and R. J. Sylvester (Aerospace Corp.) p 1–15 refs (See N67-27062 14-32)
2. DIGITAL ANALYSIS OF FATIGUE DAMAGE TO A MULTIMODAL SYSTEM SUBJECT TO LOGARITHMICALLY SWEPT SINUSOIDAL VIBRATION SPECTRA S. Fogelson (Marquardt Corp.) p 17–40 (See N67-27063 14-32)
3. ANALYSIS OF VIBRATION DISTRIBUTIONS IN COMPLEX STRUCTURES E. E. Ungar and T. D. Scharton (Bolt, Beranek, and Newman, Inc.) p 41–53 refs (See N67-27064 14-32)
4. DYNAMIC ANALYSIS OF CONTINUUM BODIES BY DIRECT STIFFNESS METHOD W. E. Baker (Rocketdyne) and J. M. Daly (Arde Eng. Co.) p 55–68 refs (See N67-27065 14-32)
5. MIN-MAX RESPONSE PROBLEMS OF DYNAMIC SYSTEMS AND COMPUTATIONAL SOLUTION TECHNIQUES E. Sevin and W. Pilkey p 69–76 refs (See N67-27066 14-32)
6. STRAIN RESPONSE OF SIMPLY SUPPORTED BEAMS TO POINT AND ACOUSTIC LOADING J. L. Parrott and J. A. Drischler (NASA, Langley Res. Center) p 77–84 refs (See N67-27067 14-32)
7. PREDICTION OF FLIGHT VIBRATION LEVELS FOR THE SCOUT LAUNCH VEHICLE R. B. Bost (LTV Aerospace Corp.) p 85–95 refs (See N67-27068 14-32)
8. RESPONSE OF STRUCTURAL COMPONENTS OF A LAUNCH VEHICLE TO IN-FLIGHT ACOUSTIC AND AERODYNAMIC ENVIRONMENTS K. L. Chandiramani and R. H. Lyon p 97–106 refs (See N67-27069 14-32)
9. DYNAMIC VIBRATIONS OF THICK-WALLED ELASTIC ANISOTROPIC CYLINDERS AND SPHERES WITH INTERNAL DAMPING G. Cinelli p 107–118 refs (see N67-27070 14-32)
10. EFFECT OF ASYMMETRICAL TRAPEZOIDAL PULSE ON SINGLE-DEGREE-OF-FREEDOM SYSTEMS A. Saunders p 119–125 refs (See N67-27071 14-32)

N67-27062# Aerospace Corp., San Bernardino, Calif.
METHOD FOR IMPROVING A DYNAMIC MODEL USING EXPERIMENTAL TRANSIENT RESPONSE DATA
Ching-v Ip, Eli P. Howard, and Richard J. Sylvester *In* NRL The Shock and Vibration Bull. Jan. 1967 p 1–15 refs (See N67-27061 14-32)

A rational method is developed for improving the mathematical dynamic model of a linear system by utilizing experimental results. The data required as input to the method consist of measurements of the applied load and some limited response information. Two examples demonstrate the improvement in the mathematical model of a six-degree-of-freedom system when the loading and limited response information is known without experimental error. Future efforts are outlined to study effects of error in experimental input data and feasibility of application to systems of many degrees of freedom. Author

N67-27063# Marquardt Corp., Van Nuys, Calif.
DIGITAL ANALYSIS OF FATIGUE DAMAGE TO A MULTIMODAL SYSTEM SUBJECTED TO LOGARITHMICALLY SWEPT SINUSOIDAL VIBRATION SPECTRA
Seymour Fogelson *In* NRL The Shock and Vibration Bull. Jan. 1967 p 17–40 (See N67-27061 14-32)

A method for calculating the fatigue damage of structures subjected to sinusoidal vibration spectra that are swept logarithmically at a given rate was developed and programmed for analysis by digital computer. It is assumed that the structure is a damped spring-mass system with each mass having three translational and three rotational degrees of freedom. Only lumped mass structures are considered. It is further assumed that the resonant amplification factors and the overall damping ratio of the structure are known. Based on this analysis, the resulting digital computer program yields the damage accumulated in each mode of response for each axis of applied excitation, the total damage accruing for each input axis, and the total damage caused by sweeping the spectrum a given number of times. Author

N67-27064# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ANALYSIS OF VIBRATION DISTRIBUTIONS IN COMPLEX STRUCTURES
Eric E. Ungar and Terry D. Scharton *In* NRL The Shock and Vibration Bull. Jan. 1967 p 41–53 refs (See N67-27061 14-32)

This paper is intended to serve as an introduction to the statistical energy analysis approach, which provides one with a relatively simple means for understanding and estimating the most significant properties of multi-modal random vibrations of complex structures. The theoretical basis for this approach is summarized, some insights resulting from its use are presented, and some applications of it to spacecraft vibration analysis and testing are discussed. Author

N67-27065# Rocketdyne, McGregor, Tex.
DYNAMIC ANALYSIS OF CONTINUUM BODIES BY DIRECT STIFFNESS METHOD
W. E. Baker and J. M. Daly (RDE Eng. Co.) *In* NRL The Shock and Vibration Bull. Jan. 1967 p 55–68 refs (See N67-27061 14-32)

A method is presented for dynamic analysis of complex continuum bodies by extension of the finite element method, to circumvent the severe oversimplification often required in treating these problems by classical methods. Axisymmetric and plane stress-strain formulations, with the associated computer programs, have been developed. The analysis was developed using viscous damping and the assumption that classical modes exist. The undamped frequencies and mode shapes are first calculated, then used to uncouple the damped equations of motion by diagonalization of the mass, damping and stiffness matrices. Thus, single-degree-of-freedom modal response equations are formed and solved for the response contribution of each mode. Through superposition of each modal contribution coupled with a transformation back to the original coordinate system, the response to an arbitrary forcing function is determined. Theoretical development, correlation studies, applications and some of the limitations of the analysis are discussed. Author

N67-27066# IIT Research Inst., Chicago, Ill.
MIN–MAX RESPONSE PROBLEMS OF DYNAMIC SYSTEMS AND COMPUTATIONAL SOLUTION TECHNIQUES
Eugene Sevin and Walter Pilkey *In* NRL The Shock and Vibration Bull. Jan. 1967 p 69–76 refs (See N67-27061 14-32)

Analysis and design problems of dynamic systems are considered in which the system and/or disturbances are not completely prescribed and the extremal peak responses are of interest. Discussions are presented of mathematical techniques of linear and nonlinear programming and dynamic programming which can be used to solve these so-called min–max problems. These techniques serve to determine not only the extremal responses but also the unknown properties of the system (the optimum design problem) and/or the disturbance (the extremal response analysis problem) which generate these responses. Detailed consideration is limited to single-degree-of-freedom dynamic systems. Author

N67-27067# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRAIN RESPONSE OF SIMPLY SUPPORTED BEAMS TO POINT AND ACOUSTIC LOADING
Tony L. Parrott and Joseph A. Drischler *In* NRL The Shock and Vibration Bull. Jan. 1967 p 77–84 refs (See N67-27061 14-32)

A comparison of measured and predicted strain responses for carefully controlled experiments on beams whose boundary conditions approximate, to a high degree of accuracy, those of a simple support is presented. The simply supported boundary condition was found to be readily amenable to mathematical analysis and characterized by low damping. Dimensions of the beams were chosen so that significant vibration amplitudes (in excess of the beam thickness) could be obtained in the fundamental mode. The beams were excited by sinusoidal and random loadings applied both acoustically (uniformly distributed along beam) and mechanically (at a point location). In addition to strain measurements, both the total equivalent viscous damping and the magnitude of the exciting force were obtained. In general, good agreement between measured and predicted dynamic bending strain was obtained. Author

N67-27068# LTV Aerospace Corp., Dallas, Tex. Astronautics Div.
PREDICTION OF FLIGHT VIBRATION LEVELS FOR THE SCOUT LAUNCH VEHICLE
Robert B. Bost *In* NRL The Shock and Vibration Bull. Jan. 1967 p 85–95 refs (See N67-27061 14-32)

A prediction procedure developed in the process of establishing random vibration criteria for the Scout launch vehicle is presented. The procedure was designed to define the acoustically induced random vibration environment throughout the Scout vehicle by using the limited data sample from six vehicles. A transfer function relating the internal vibration level to the external noise level was established by use of the measured vibration data and the calculated external noise levels at the point of measurement. This transfer function was then used to calculate the expected vibration levels in each area of the vehicle from the noise level at each location. Statistical methods were used to establish confidence levels for these calculations. The success of the prediction procedure is demonstrated by comparison of the predicted vibration levels with measured data obtained on subsequent Scout flights. Author

N67-27069# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
RESPONSE OF STRUCTURAL COMPONENTS OF A LAUNCH VEHICLE TO IN-FLIGHT ACOUSTIC AND AERODYNAMIC ENVIRONMENTS
Khushi L. Chandiramani and Richard H. Lyon *In* NRL The Shock and Vibration Bull., Jan. 1967 p 97–106 refs (See N67-27061 14-32)

A unified system of procedures is developed for estimating some important classes of in-flight noise environments and the resulting surface vibration on a typical launch vehicle. Noise environments are classified according to the nature of the spatial and temporal correlations of the associated fluctuating pressure fields. The structural elements considered are a cylinder and a flat plate. The presentation is general enough to apply to orthotropic and liquid-loaded structures. Some numerical examples are presented for estimates of frequency spectra of acceleration on the vibrating structures. Author

N67-27070# Argonne National Lab., Ill.
DYNAMIC VIBRATIONS OF THICK-WALLED ELASTIC ANTISOTROPIC CYLINDERS AND SPHERES WITH INTERNAL DAMPING
Gabriel Cinelli *In* NRL The Shock and Vibration Bull. Jan. 1967 p 107–118 refs (See N67-27061 14-32)

A new finite Hankel transform is used to find the transient displacement and stresses in thick elastic cylinders and spheres composed of material with transverse curvilinear isotropy and internal viscous damping for the following problems: (a) plane strain motion of an infinitely long circular cylindrical shell, (b) torsional motion of a finite circular cylindrical shell, and (c) radially symmetric motion of a spherical shell. The dynamic loads on the surfaces are taken as arbitrary functions of space (torsional case only) and time. It is shown that the problems of the solid body, the thin shell, and cavity in an infinite medium can be obtained from the thick shell solution as limiting cases. Specializing the surface tractions to standard forms such as an impulse or a sinusoid, the free, harmonic, and static motions are recovered. Physical quantities such as resonance and mechanical impedance are derived and studied. Using the displacement equations, it is shown that the radially symmetric motion is analogous to the plane-strain motion of the cylinder. Author

N67-27071# General Electric Co., Philadelphia, Pa.
EFFECT OF ASYMMETRICAL TRAPEZOIDAL PULSE ON SINGLE-DEGREE-OF-FREEDOM SYSTEMS
A. Saunders *In* NRL The Shock and Vibration Bull. Jan. 1967 p 119–125 refs (See N67-27061 14-32)

Equations are derived for predicting the maximum acceleration response of a physically obtainable asymmetrical trapezoidal pulse. The equations employ the actual rise, decay and dwell portions of the pulse. Since most physical systems contain little or no damping, an undamped one degree of freedom is employed. The solution is obtained by utilizing the Laplace transform method in terms of the Dirac delta function. Comparisons are made between the theoretical rectangular pulse and a few trapezoidal pulses having different rise, decay and dwell times. The rectangular pulse is the most severe. The rise and decay times have a secondary effect on the response; the dwell time has the most important effect. By using the derived equations, the designer can evaluate the degree of departure between the idealized and actual test condition and can thus define an equivalent trapezoidal pulse capable of furnishing a similar response in the component. Author

N67-27107# North American Aviation, Inc., Columbus, Ohio.
APPLICATION OF APPLIED LOAD RATIO STATIC TEST SIMULATION TECHNIQUES TO FULL-SCALE STRUCTURES. VOLUME IV: SUMMARY OF RESULTS, CONCLUSIONS AND RECOMMENDATIONS
R. W. Gehring and C. H. Maines Philadelphia, Naval Air Eng. Center, 31 Aug. 1966 127 p refs
(Contract N156-45330)
(NAEC-ASL-1094, Vol. IV; AD-648746) CFSTI: HC $3.00/MF $0.65

The overall objective of the study is to investigate the applicability of the applied load ratio method to full scale aircraft structural components. Volume IV is a report on the correlation of theoretical and experimental results. The conclusion is that the applied load ratio method gives accurate predictions for structures loaded in elevated temperature environments to fail in bending and shear. Failure predictions apply either to a mechanically fastened splice joint or to areas where plane-strain cross-sections exist. Author (TAB)

N67-27180# Naval Applied Science Lab., Brooklyn, N. Y.
FATIGUE ON LARGE SCALE UNIFORMLY LOADED SIMPLY SUPPORTED TEE-FILLET WELDED RECTANGULAR RIB-STIFFENED PLATES
M. Rosen 17 Mar. 1967 18 p refs
(TM-7; AD-648769) CFSTI: HC $3.00/MF $0.65

Fatigue and crack growth data were obtained on the final specimen in a series of tee-fillet welded rib-stiffened plate type specimens 56 by 28 by 1 1/2 in. fabricated from HY-80 steel. The specimen was subjected to cyclical loading at a nominal stress range of zero to 60,000 psi in the NASL plate type fatigue machine which permits application of a uniform pressure to a plate that is simply supported at four edges. Data were obtained on the initiation and growth of fatigue cracks, fatigue life, effect of weld notch acuity, and effect of cyclical loading at lower nominal stresses after a fatigue crack of 20 percent of the depth of the specimen was formed. TAB

N67-27272*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMIC SIMULATION OF LUNAR MODULE DOCKING WITH APOLLO COMMAND MODULE IN LUNAR ORBIT
Howard G. Hatch, Jr., Jack E. Pennington, and Jere B. Cobb Washington, NASA, Jun. 1967 28 p refs
(NASA-TN-D-3972) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A full-size pilot-controlled simulation of the Lunar-Orbit-Rendezvous docking of the lunar module (LM) with the command and service module (CSM) has been conducted on the six-degree-of-freedom Langley rendezvous docking simulator. Docking the ascent stage of the LM with its top hatch to the CSM was studied, and pilots performed the maneuver with only visual observation of the target for guidance information. The objectives of the simulation were to determine if visual aids were needed to complete the docking and to determine the effects of lighting conditions, control mode, and pressure suit on the mission. The results showed that the pilots could dock within specified tolerances if visual aids were used. The most desirable visual aids were a collimated recticle aid in the LM and an illuminated standoff cross in the CSM. The lighting conditions studied had no effect on docking when visual aids were used. The most desirable control modes were the direct mode for translation control and rate command with attitude hold for attitude control. The direct attitude control mode was extremely difficult. When the pilot was wearing a pressurized suit, he found that control was degraded somewhat. Author

N67-27314*# National Aeronautics and Space Administration. Washington, D. C.
TRANSVERSE ELASTIC IMPACT OF A SPHERE AGAINST AN ANISOTROPIC PLATE [ROPERECHNYY UPRUGIY UDAR SHAROM PO ANIZOTROPNOY PLASTINKE]
N. A. Kil'chevskiy and A. Kh. Konstantinov May 1967 6 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 2, no. 11, 1966 p 1–4
(NASA-TT-F-10971) CSCL 20K

The deflection of a plate, the force of interaction between an isotropic elastic sphere and an anisotropic plate, and the duration of the impact, are determined on the basis of previously developed methods. Emphasis is on the effect of anisotropy of the plate material on the duration of impact. This influence is shown to vary with the ratio of the sides of the plate. Author

N67-27387*# General American Transportation Corp., Niles, Ill. Research Div.
TRANSPORTATION AND HANDLING SHOCK AND VIBRATION ENVIRONMENTAL CRITERIA Final Report
Fred E. Ostrem and M. L. Rumerman 28 Apr. 1967 119 p refs
(Contract NAS8-11451)
(NASA-CR-84408; MR-1262-2) CSCL 20K

A comprehensive literature survey and search was conducted for data and information applicable to the cargo handling environment. Approximately 150 reports and articles were reviewed and over 50 agencies or organizations concerned with problems of this nature were contacted. The information compiled is summarized to show the distribution of drop heights for particular packages, distribution systems, and handling operations. Other information on the handling environment such as the number of drops received per package per trip, the distribution of the drops over the faces, edges and corners, the effect of package size and weight, the effect of the distribution system and the effect of labels and handholds are also presented. A case history for paper sacks is presented which describes the complete drop height history from manufacturer to customer. Applications of the data to typical package design problems are discussed. Results of recent measurement programs of the transportation shock and vibration environment are also presented. Author

N67-27415*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
AN INVESTIGATION OF THE RESPONSE OF A SCALED MODEL OF A LIQUID-PROPELLANT MULTISTAGE LAUNCH VEHICLE TO LONGITUDINAL EXCITATION
William M. Thompson, Jr. Washington, NASA, May 1967 68 p
(NASA-TN-D-3975) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The longitudinal vibration characteristics of a scaled dynamic model of a liquid-propellant multistage launch vehicle were investigated experimentally and analytically. Experimental data were obtained for the model when sinusoidally excited in the longitudinal direction through the stage I engine gimbals. The structure was supported in a suspension system that offered negligible restraint to longitudinal motion, and the vibration response was measured with different simulated fluid-propellant loadings representing flight times of 0 sec (stage I engine ignition) 40 sec, 80 sec, 120 sec, and 152 sec (stage I engine burnout). These results are presented and discussed. Longitudinal vibration response of the model was computed by using a two-dimensional mathematical model consisting of axisymmetric shell, fluid, and mass components. A comparison of computed and measured results shows good agreement for the two basic longitudinal structural modes. Author

N67-27421*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
APPLICATION OF THE METHODS OF LIMIT ANALYSIS TO THE EVALUATION OF THE STRENGTH OF FIBER-REINFORCED COMPOSITES
L. S. Shu and B. W. Rosen Jan. 1967 38 p refs
(Contract NASw-1377)
(NASA-CR-84450) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The in-plane shear strength and the transverse strength in shear and in tension of composites comprised of elastic–brittle fibers and an elastic perfectly plastic binder are evaluated quantitatively in terms of the matrix yield strength and volume fraction. The results are in the form of bounds obtained by the application of the theorems of limit analysis of plasticity. Author

N67-27528*# International Information, Inc., Philadelphia, Pa.
FLUTTER OF A CYLINDRICAL SHELL IN A STREAM OF COMPRESSIBLE CONDUCTIVE FLUID IN THE PRESENCE OF A MAGNETIC FIELD [FLATTER TSILINDRICHESKOY OBOLOCHKI V POTOKE SZHIMAYEMOY PROVODYASCHEY ZHIDKOSTI V PRISUTSTVII MAGNITNOGO POLYA]
G. Ye. Bagdasaryan and M. V. Belubekyan Mar. 1967 11 p Transl. into ENGLISH from Inzh. Zh. (USSR), no. 6, 1966 p 50–56
(Contract NASw-1499)
(NASA-TT-F-10741) CSCL 20K

An investigation is made of the stability of a circular cylinder of infinite length, flowed around by a stream of an ideal, conductive, nonviscous gas. Within the shell the gas is in a state of rest under pressure equal to the pressure of an unperturbed stream. The external magnetic field is parallel to the flow velocity. In the investigation the Kirchhoff–Love hypothesis on undeformable normals is valid; simplifications in shell theory with a high index of changeability are introduced; electromagnetic effects in the shell are not investigated; the magnetic permeability and the dielectric constants of the gas and the shell material are considered equal to unity; and within the shell the Maxwell equations for vacuum are valid. Author

N67-27529*# International Information, Inc., Philadelphia, Pa.
THE EFFECT OF THE ELASTICITY OF RIBS ON THE TORSION STRESSED STATE OF A CIRCULAR CYLINDRICAL SHELL WITH A RECTANGULAR OPENING [ISSLEDOVANIYE VLIYANIYA UPRUGOSTI SHAPANGOUTOV N NAPRYAZHENNOYE SOSTOYANIYE KRUGOVOY TSILINDRICHESKOY OBOLOCHKI S PRYAMOUGOL'NYM VYREZOM PRI KURCHENII]
S. I. Galkin and Y. Ye. Levitskaya Mar. 1967 6 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), no. 6, 1966 p 136–138
(Contract NASw-1499)
(NASA-TT-F-10744) CSCL 20K

The authors analyze previously obtained solutions applicable to the torsion problems with circular cylindrical shells with rectangular openings reinforced with elastic ribs. Programs were compiled by means of electronic digital computers for shell designs with rectangular openings. Author

N67-27534*# International Information, Inc., Philadelphia, Pa.
TRANSMISSION OF CONCENTRATED STRESSES TO A THIN WALLED SHELL [O PEREDACHE SOSREDOTOCHENNYKH SIL NA TONKOSTENNUYU OBOLOCHKU]
V. I. Feodos'yev and S. M. Chernyakov Mar. 1967 12 p Transl. into ENGLISH from Inzh. Zh. (USSR), no. 6, 1966 p 57–63
(Contract NASw-1499)
(NASA-TT-F-10742) CFSTI: HC $3.00 CSCL 20K

The transmission of stresses to a thin-walled shell over a limited contact region is studied. It is shown that when the shell is completely free from radial stresses on the side of the insert, but clamping is retained, the values of the radial force are decreased by approximately a factor of two. Author

N67-27535*# International Information, Inc., Philadelphia, Pa.
DESIGN OF THE CYLINDRICAL SHELL FOR CYCLIC LOADING [RASCHET TSILINDRICHESKOY OBOLOCHKI NA TSIKLICHESKIYE NAGRUZKI]
N. Petrova-Deneva Mar. 1967 15 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), no. 6, 1966 p 106–114
(Contract NASw-1499)
(NASA-TT-F-10743) CFSTI: HC $3.00 CSCL 20K

The asymptotic integration method, previously used for the design of shells of revolution for cyclic loading, is used to obtain a solution for the closed cylindrical shell of random cross section subjected to cyclic loading. Author

N67-27547# Technische Hochschule Stuttgart (West Germany).
THE MATRIX EIGENVALUE PROBLEM FOR DAMPED STRUCTURAL VIBRATIONS
P. C. Patton and Kari-Appa Apr. 1966 25 p refs
(Rept.-27)

Equations of motion are applied to cases of free vibrations in both proportionally and nonproportional damped structures. The orthogonality of damped modes is discussed. A Fortran IV program for von Mises' method for solving a damped system was written for an iteration process based on a given matrix equation. The A–P algorithm was also applied to the generalized and to higher order nonlinear eigenvalue problems. L.S.

N67-27564*# Scientific Translation Service, La Canada, Calif.
THE STRESSES AND FORM CHANGES WITH RECTANGULAR CROSS SECTIONS [DIE SPANNUNGEN UND FORMANDERUNGEN VON BALKEN MIT RECHTECKIGEM QUERSCHNITT]
F. Seewald Washington, NASA, Jun. 1967 27 p ref Transl. into ENGLISH of Abhandl. Aerodynamischen Inst. an der Tech. Hochschule (Aachen), no. 7, 1927 p 11–33
(Contract NASw-1496)
(NASA-TT-F-10990) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The present paper first shows how one may obtain closed formulas for stresses, curvature and bending line for any arbitrary loading. Furthermore, we investigate the stress state and form change for a type of discontinuous loading, namely, for the loading by concentrated forces. It is found that the solution is composed of one portion which is identical to the elementary theory, and one portion which may be calculated once and for all for a load P. It is also shown that the solution may be extended for any arbitrary loading state by superposition. Finally, we attempt to estimate the magnitude of the error which is caused by not satisfying the boundary conditions at the end cross sections. According to this, the solution given here seems to be sufficiently accurate for all practical cases. Only for the very rare case in which beam length is small as compared with the beam height, can one expect a deviation from the results calculated here. Author

N67-27568*# Scientific Translation Service, La Canada, Calif.
THE FOUNDATIONS OF BEAM THEORY [UBER DIE GRUNDLAGEN DER BALKENTHEORIE]
Th. v. Karman Washington, NASA, Jun. 1967 11 p refs Transl. into ENGLISH of Abhandl. Aerodynamischen Inst. an der Tech. Hochschule (Aachen), no. 7, 1927 p 3–10
(Contract NASw-1496)
(NASA-TT-F-10989) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The bending of simply supported beams subject to concentrated loads and continuous loads is discussed using Airy stress functions. Author

N67-27610*# Farnham (Frank C.) Co., Philadelphia, Pa.
A MULTIMODULUS ELASTICITY THEORY [K RAZNOMODUL'NOY TEORII UPRUGOSTI]
S. A. Ambartsumyan and A. A. Khachatryan Washington, NASA, May 1967 8 p refs Transl. into ENGLISH from Mekhan. Tverdogo Tela (USSR), no. 6, 1966 p 64–67
(Contract NASw-1497)
(NASA-TT-F-10986) CFSTI: $3.00 CSCL 20K

This paper considers certain questions regarding the application of elasticity theory to bodies whose materials resist extension and compression in different ways. Some formulas and theorems of the classical theory of elasticity are presented and their validity is demonstrated for the considered material. Author

N67-27665*# Texas A&M Univ., College Station. Texas Engineering Experiment Station.
THE ANALYSIS OF STRUCTURALLY ORTHOTROPIC SHELLS BY MEANS OF THE COMPLIANCE METHOD Progress Report
Thomas J. Kozik 1 Jun. 1967 17 p
(Grant NGR-44-001-031)
(NASA-CR-84507) CFSTI: $3.00 CSCL 20K

Progress is reported on a study which is being conducted to: (1) extend compliance studies to general shell configurations with general type reinforcements, (2) program the compliance equations to account for stiffeners not amenable to simple algebraic analysis, (3) initiate a limited testing program for stiffened shallow shells in order to experimentally verify the compliance equations, and (4) perform a non-linear analysis for shallow shells in order to determine the non-linear compliance equations. At present, the greatest effort has been directed toward objective number three. However, all of the objectives have been acted upon in varying degrees of effort, though none have been brought to a state of completion. A detailed discussion of the results obtained for each of the listed objectives is given. Author

N67-27673*# Stanford Univ., Calif.
THEORETICAL STUDIES OF SOME NONLINEAR ASPECTS OF HYPERSONIC PANEL FLUTTER Status Report, 1 Sep. 1966–28 Feb. 1967
K. Karamcheti Feb. 1967 7 p refs
(Grant NGR-05-020-102)
(NASA-CR-84515; Rept.-3) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Two specific pilot problems have been investigated, one illustrating the application of a variational principle to a so-called nonconservative system and the other demonstrating an inherent weakness of the Galerkin procedure when it is applied to the solution of differential equations in a purely mathematical sense. To illustrate that a variational formulation of 'a so-called nonconservative-system problem can be carried out, the classical problem of the follower-force column-buckling problem is undertaken. Bolotin's classical solution, found by differential-equation solution, is used. Bolotin's work on a two-dimensional simply supported plate with aerodynamic loads from second-order piston theory and variable in-plane edge restrain, and Stepanov's study of a three-dimensional simply supported plate with infinite in-plane edge restraint and second-order piston theory aerodynamic loads which include some aerodynamic damping terms, are discussed in relation to evaluating the effects of aerodynamic nonlinearities. Author

N67-27711# Technische Hochschule Stuttgart (West Germany).
APPLICATION OF THE A–P ALGORITHM TO NON-PROPORTIONALLY DAMPED VIBRATION PROBLEMS
P. C. Patton [1966] 14 p refs Presented at the Symp. on Numerical Methods for Vibration Probl., Univ. of Southampton, 15 Jul. 1966
CFSTI: HC $3.00/MF $0.65

The A–P algorithm was originally formulated for the eigenreduction of real symmetric matrices but has been extended in recent years to handle real and, finally, normalizable complex matrices. Considerable experience with the method for the determination of normal modes of free vibration and buckling modes in complex structures has indicated it to be an efficient computer method. Of interest here is an application of the method to vibration problems represented by the non-selfadjoint matrix differential equation $M\ddot{q}+C\dot{q}+Kq=0$ in which C is proportional to neither M nor K. The reduced dynamical matrix of such a system is a supermatrix which can be diagonalized by the A–P algorithm to find the complex eigenvalues (i.e., damping factors and frequencies) and complex eigenvectors (damped normal modes). The extension of this problem to include aerodynamic damping and stiffness is discussed with reference to a dynamic stability analysis

based on the free–free antisymmetric modes of a whole aircraft. In this case, C and K include aerodynamic effects and are parameterized by air speed V and thus D is parameterized by V as well. The A–P algorithm is shown to be particularly effective for the eigenvalue analysis of the sequence of eigenproblems $D(V)x = \lambda x$, $V = V_0, V_1, \ldots, V_n$. Author

N67-27715# Marine Engineering Lab., Annapolis, Md.
LOW-CYCLE FATIGUE BEHAVIOR OF INTERNALLY PRESSURIZED BOXES
M. R. Gross Mar. 1967 38 p refs
(MEL-5/67; AD-648154) CFSTI: HC$3.00/MF$0.65

One phase of a continuing study of the low-cycle fatigue behavior of metals for deep-submergence structural applications involves the validity of simple specimen results when applied to complex structures. As part of this study, the low-cycle fatigue performance of internally pressurized boxes was investigated. The boxes were constructed from 1-inch-thick plate of 11 materials consisting of six steels, one aluminum alloy, one cupronickel alloy, and three titanium alloys. A previous report described the results obtained from 12 boxes. This report describes the results obtained from an additional 15 boxes. The results provide additional confirmation of conclusions obtained from simple specimen tests, i.e., (1) increases in low-cycle fatigue strength for a given life are not proportional to increases in yield strength, and (2) low-cycle fatigue life is closely related to total strain range and appears to be independent of both structural metal and strength level in the life range of 1,000 to 30,000 cycles. Conclusions are also reached regarding effects of such variables as joint geometry, corrosivity of environment, stress relief, and notch toughness. Author (TAB)

N67-27716# California Univ., San Diego. Dept. of the Aerospace and Mechanical Engineering Sciences.
STABILITY OF CYLINDRICAL SHELLS UNDER MOVING LOADS BY THE DIRECT METHOD OF LIAPUNOV
G. A. Hegemier Jan. 1967 34 p refs
(Contract N00014-67-A-0109-0003)
(TR-5; AD-646709) CFSTI: HC$3.00/MF$0.65

The stability of a long, thin, elastic circular cylindrical shell subjected to axial compression and an axisymmetric load moving with constant velocity along the shell axis is studied. With the aid of the direct method of Liapunov, and employing a nonlinear Donnell-type shell theory, sufficient conditions for local stability of the axisymmetric response are established in a functional space whose metric is defined in an average sense. Numerical results, which are presented for the case of a moving decayed step load, reveal that the sufficient conditions for stability developed here and the sufficient conditions for instability obtained in a previous paper lead to the actual stability transition boundary. Author (TAB)

N67-27721# Lockheed Missiles and Space Co., Palo Alto, Calif.
VIBRATIONS OF A CIRCULAR CYLINDRICAL SHELL WITH A GAS FLOWING WITHIN IT
D. A. Derbentsev [1967] 6 p refs Transl. into ENGLISH from Prikl. Mech., Akad. Nauk Ukr. RSR (Kiev), v. 3, no. 3, 1967 p 14–19

The vibrations and stability of a finite circular cylindrical shell with a supersonic gas flowing within it are considered. Exact formulas, obtained earlier from a linearized theory, are utilized for the aerodynamic forces. The problem is reduced to integro-differential equations which are then solved by the Bubnov–Galerkin method. It is shown in an example that the critical flutter velocity is considerably lower than in previous work where the aerodynamic forces were computed by piston theory. Author

N67-27731# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE FRACTURE TIME OF SHELLS UNDER CREEP CONDITIONS
L. M. Kachanov [1966] 7 p refs Transl. into ENGLISH from Fiz. i Geometricheski Nelin. Teorii Plastin i Obolochek (Tartu), v. 1, 1966 p 45–57
CFSTI: HC$3.00/MF$0.65

Two aspects to the creep problem in metal shells are considered. The first involves determining the stresses and strains in the body, and the second is concerned with determining the time to fracture. Solutions are given to the problem of the time of viscous fracture of thin walled shells of revolution under internal pressure and axial stress. The problems of pure brittle fracture of shells and fracture of a mixed type are also analyzed. R.N.A.

N67-27732# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE BEHAVIOR OF PLASTIC STRUCTURES UNDER THE PULSE EFFECT OF LOADING
G. S. Shapiro [1967] 6 p refs Transl. into ENGLISH from Fiz. i Geometrich. Nelineinnye Zadachi Teorii Plastin i Obolochek (Tartu), v. 1, 1966 p 258–267
CFSTI: HC$3.00/MF$0.65

A survey is made of research concerned with the dynamics of ideal rigid plastic structures under the effects of dynamic loading. The discussion covers research devoted to such general questions of theory as the uniqueness and variational principles, the construction of approximate methods, the applicability limits of rigid plastic structural analysis, and problems of dynamic yield criteria. The discussion also considers solutions of specific problems and their experimental verification, as well as research involving the flexure of beams, rings, plates, and shells. R.N.A.

N67-27753*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
USE OF SLURRIES FOR HYDROSTATIC TESTING
Frederic E. Wells *In its* Res. Achievements Rev., Vol. II, No. 5 1966 p 9–11 (See N67-27751 14-15)

The hydrostatic proof testing of tanks to their full flight loads by the use of slurries is discussed. Guidelines for necessary slurry characteristics are established. Tests were conducted for slurry viscosity under shear stresses, for exposure to sunlight, for compatibility with two cryogenic liquids, and for corrosion on various tank surface materials. The economics of producing slurries with the required specific gravity is mentioned. Author

N67-27756# Martin Co., Baltimore, Md.
NUMERICAL ANALYSIS OF ELASTO–PLASTIC WAVE PROPAGATION
Norris J. Huffington, Jr. Apr. 1967 70 p refs
(RM-326)

The propagation of elastoplastic stress waves in a one-dimensional medium is analyzed by the finite difference method, employing a rectangular grid of mesh points in the space-time plane. This approach can be adapted for materials having a variety of dynamic characteristics; specific application is made to a rate-independent material having hysteretic and rehardening behavior which can be approximated by piece-wise linear segments. Digital computer programs are presented for analysis of a single elastoplastic bar and for a three-bar configuration corresponding to a practical impact test apparatus which has been employed to determine the dynamic properties of crushable materials used as energy absorbers. Results obtained from the computer program for the single bar compare favorably with an available exact solution. Author

N67-27766# McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.
NUMERICAL ANALYSIS OF AXIALLY SYMMETRIC SPHERICAL SHELLS

P. J. Harris Feb. 1967 21 p refs *Its* Vol. 10, No. A-1
(EIC-67-BR & STR-2) CFSTI: HC $3.00/MF $0.65

This paper deals with the computation and study of small elastic displacements and stresses in axially symmetric spherical shells. All loads and reactions are assumed to be symmetrical with respect to the axis of the shell and consequently the displacements and stresses are functions of only one independent variable, the co-latitude. The author has developed a computer program which will solve the differential equations of equilibrium in their finite difference form. No terms are dropped (although some might be with no loss of accuracy in certain cases) and within the limitations of axial symmetry, the computer program can handle any type of loading, any type of boundary condition, and any kind of thickness variation. The material of the shell is assumed to be homogeneous and isotropic. Author

N67-27775# Mitsubishi Heavy-Industries, Ltd., Nagasaki (Japan).
INVESTIGATION INTO THE PROPELLER CAVITATION IN OBLIQUE FLOW
Mar. 1967 8 p refs *Its* Tech. Bull.-45
(Contract Nonr-5002(00))
CFSTI: HC $3.00/MF $0.65

In order to serve the improvement of performance prediction of high-speed vessels, theoretical and experimental investigations into the propeller cavitation in oblique flow condition were carried out. As a first step, a simple quasi-steady method of calculation was developed to estimate the propeller characteristics in oblique flow condition from those in axial flow condition. Then a series of supercavitating propellers were tested in cavitating oblique flow condition to confirm the validity of the quasi-steady method of calculation. The test results were found to be in fairly good agreement with the propeller characteristics estimated by the quasi-steady method. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N67-26494# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
TURBULENT HEAT TRANSFER IN THE THERMAL ENTRANCE REGION OF A PERFECTLY INSULATED PIPE
Final Scientific Report
John W. Goresh and Robert G. Dunn Sep. 1966 47 p refs
(ARL-66-0178; AD-648497) CFSTI: HC $3.00/MF $0.65

The problem considered is that of finding the thermal entrance or thermal mixing region of a pipe where the wall heat flux is zero along the length of the pipe. The fluid is assumed to enter the pipe with a non-uniform temperature profile and a fully developed turbulent velocity profile. The approach is analogous to that introduced by Fettis for the solution of the uniform wall temperature problem. The results for different radii tubes and Reynolds numbers are presented in graphs which show the adjustment of the temperature profile down the pipe. These results provide information concerning the minimum length mixing tube, since any wall losses will require a greater length. Author (TAB)

N67-26498# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
SPECTROGRAPHIC ANALYSIS OF ROCKET NOZZLE FLOW
Hilbert J. Unger, Freeman K. Hill, and William P. Dickens Jan. 1967 101 p refs
(Contract NOw-62-0604-c)
(TG-877; AD-648321) CFSTI: HC $3.00/MF $0.65

Spectral analysis of the radiation from combustion products of solid propellants in supersonic flow is used to determine the composition and temperature of the gas. The spectrographic equipment and rocket apparatus are described and the experimental results obtained are compared with theory. The flow system examined is that of combustion gases passing through a rocket nozzle where the stagnation temperature and pressure correspond to 2500K and 75 atmospheres. The rapid expansion of the flow in the supersonic part of the nozzle gives rise to non-equilibrium conditions. The spectrometer is used to determine the concentration of one of the active species, CO2, as a function of distance down the nozzle. It is shown that the experimental results agree very closely with the prediction of flow performance based on chemical kinetics. Both emission and absorption spectra were obtained of CO2, CO and H2O in the range from 4 to 6.5 microns. The spectral measurements also enabled the static free-stream temperature of the gas to be determined. Author (TAB)

N67-26572*# International Information, Inc., Philadelphia, Pa.
PROTECTIVE COOLING BY A MULTISLOT AND NETWORK-TYPE INJECTION INTO A TURBULENT BOUNDARY LAYER [ZAGRADITEL'NOYE OKHLAZHDENIYE PRI MNOGOSHCHELEVOM I RESHETCHATOM VDUVE V TURBULENTNYY POGRANICHNYY SLOY]
E. P. Volchkov, S. S. Kutateladze, V. La. Levchenko, and A. I. Leont'ev Washington, NASA, Dec. 1966 10 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 3, 1966 p 149–153
(Contract NASw-1499)
(NASA-TT-F-10643) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The effectiveness of a protective cooling of an insulated plane surface by gas injection into the turbulent boundary layer of the incident flow through a system of slots is considered. An analytical method is developed to assess the results of such a cooling technique, taking the dimensionless temperature of the surface as the measure of its effectiveness. Author

N67-26577*# National Aeronautics and Space Administration, Washington, D. C.
THERMAL RADIATION [TEPLOVOYE IZLUCHENIYE]
M. M. Kheyev Mar. 1967 41 p Transl. into ENGLISH from the book "Osnovy Teploperedachi" (Moscow), Gosenergoizdat, 1956 p 144–168
(NASA-TT-F-10809) CFSTI: $3.00 CSCL 20M

The fundamental physical concepts and definitions associated with the physics of heat radiation are presented. Procedures are developed for calculating radiant heat transfer between plane parallel surfaces and between bodies in closed space including cases when screens are used between bodies. Two examples are worked out involving radiation of heat by a steel tube inside a brick structure and the radiation of heat by a horizontal surface covered with black paint. Author

N67-26629*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LITHIUM-BOILING POTASSIUM TEST LOOP
Gerald M. Kikin, Jerry P. Davis, Daniel G. Griffin, Maurice L. Peolgren, and Wayne M. Phillips 15 Sep. 1966 67 p refs
(Contract NAS7-100)
(NASA-CR-84294; JPL-TR-32-1083) CSCL 20M

The construction, instrumentation, and initial phases of operation of the test loop are described. The loop, constructed of niobium-1% zirconium, operates at 30-kW heat input and temperatures up to 2100° F. The primary loop heat source, which is by electric current resistance heat generation in a section of the tube wall, may be programmed to nuclear reactor kinetic

equations for simulation of power response to various system perturbations. The secondary loop includes a refractory metal, single-wheel, reentry-type turboalternator operating at 12,000 rpm. The system was operated at full power and temperature. Several modes of boiling instabilities were noted during startup. Full-power, steady state boiling was stable. This initial phase of operations has provided valuable experience in liquid metal system startup and shutdown, high temperature instrumentation, control, boiling stability, and general operational characteristics. Author

N67-26742# Ohio State Univ., Columbus. Dept. of Mechanical Engineering.
AN ANALYTICAL STUDY OF THE HEAT TRANSFER FROM AN ELECTRIC ARC IN CROSS-FLOW Final Scientific Report, 15 Aug. 1965–30 Jun. 1966
L. S. Han and D. H. Kihara Oct. 1966 114 p refs
(Contract AF 33(615)-3205)
(ARL-66-0193; AD-648646) CFSTI: HC $3.00/MF $0.65

To study the heat transfer from a nitrogen arc in cross-flow, the arc is represented by a solid cylinder. Results obtained by assuming the nitrogen within the cylinder to be (1) a transparent gas, (2) a grey gas, and (3) a gas which emits radiation only at the surface of the cylinder are compared. A temperature profile for the grey-gas model was found to differ but slightly from that for the transparent-gas model. The study shows that if the cross-flow rate, the electric field strength, and the arc current are known, the arc radius, the centerline temperature and the peripheral temperature can be calculated. Graphs relating these parameters are given for a nitrogen arc over a wide range of conditions. Author (TAB)

N67-26747# Purdue Univ., Lafayette, Ind. Heat Transfer Lab.
TRANSIENT ENERGY TRANSFER IN A RADIATING GAS DURING EXPANSION Final Report
R. Viskanta Jan. 1967 14 p refs
(Contract DA-31-124-ARO(D)-137)
(AROD-4282-7-E; AD-648729) CFSTI: HC $3.00/MF $0.65

The objectives of the research were the following: (1) Study the transient cooling by thermal radiation of a spherical mass of gas during expansion. (2) Study the unsteady energy transfer in a hot core of a radiating gas which is expanding into colder surroundings which are capable of absorbing and emitting radiation. (3) Study the effect of incident radiation flux (from some external source) on the transient energy transfer and motion of a radiating gas. The purpose was to predict the state of the gas (i.e., its pressure, density and temperature distributions), the local velocity, the local radiation flux and the position of the expanding boundary as a function of time. Author (TAB)

N67-26791# Sandia Corp., Albuquerque, N. Mex. Space Isotope Power Dept.
PROCEEDINGS OF JOINT ATOMIC ENERGY COMMISSION/SANDIA LABORATORIES HEAT PIPE CONFERENCE, VOLUME I
Oct. 1966 91 p refs Conf. Held in Albuquerque, N. Mex., 1 Jun. 1966
(Contract AT(29-1)-789)
(SC-M-66-623; CONF-660645) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. STATUS OF THE ENGINEERING THEORY OF HEAT PIPES T. R. Cotter (Los Alamos Scientific Lab.) p 5–9 (See N67-26792 14-33)

2. HEAT PIPE CAPABILITY EXPERIMENTS J. E. Kemme (Los Alamos Scientific Lab.) p 11–25 refs (See N67-26793 14-33)

3. OPERATING LIMITS OF THE HEAT PIPE A. Carnesale, A. H. Cosgrove, and J. K. Ferrell (N. Carolina State Coll.) p 27–44 refs (See N67-26794 14-33)

4. FEASIBILITY STUDIES OF SPACE RADIATORS USING VAPOR CHAMBER FINS H. C. Haller and S. Lieblein (NASA, Lewis Res. Center) p 47–67 refs (See N67-26795 14-33)

5. NOTES ON HEAT PIPES AND VAPOR CHAMBERS AND THEIR APPLICATION TO THERMAL CONTROL OF SPACECRAFT S. Katzoff (NASA, Langley Res. Center) p 69–89 refs (See N67-26796 14-33)

N67-26792# Los Alamos Scientific Lab., N. Mex.
STATUS OF THE ENGINEERING THEORY OF HEAT PIPES
T. R. Cotter *In* Sandia Corp. Proc. of Joint AEC/Sandia Lab. Heat Pipe Conf., Vol. I Oct. 1966 p 5–9 (See N67-26791 14-33)

The current theory for design and performance analysis of heat pipes is summarized briefly, and the principal areas limiting their development are discussed. Author

N67-26793# Los Alamos Scientific Lab., N. Mex.
HEAT PIPE CAPABILITY EXPERIMENTS
J. E. Kemme *In* Sandia Corp. Proc. of Joint AEC/Sandia Lab. Heat Pipe Conf., Vol. I Oct. 1966 p 11–25 refs (See N67-26791 14-33)

Axial heat transfer limits were determined as a function of temperature for some 3/4-inch OD×12-inch long heat pipes. This information was obtained at temperatures from 450 to 850°C by using K and Na as working fluids. The wicks consisted of many axial channels cut into the inner wall of each tube. The vapor passage diameter was essentially 1.5 cm for all tests, but sizes of the capillary channels were varied both in width and depth. In some cases, one layer of fine screen was used to cover the channels and separate them from the vapor passage. Heat transfer limits were measured from 200 watts to 4000 watts as dictated by the heat removal system. Results obtained within this range show the effect of temperature, working fluid, channel size, and the use of screen. Startup problems and lower heat transfer rates than those predicted by theory were encountered at low temperatures. These problems appear due to an interaction between low density, high velocity vapor, and returning liquid. A layer of screen covering the liquid capillary return system helps startup and substantially increases the maximum heat transfer rate of a heat pipe throughout its useful temperature range. Author

N67-26794# North Carolina State Coll., Raleigh.
OPERATING LIMITS OF THE HEAT PIPE
A. Carnesale, J. H. Cosgrove, and J. K. Ferrell *In* Sandia Corp. Proc. of Joint AEC/Sandia Lab. Heat Pipe Conf., Vol. I Oct. 1966 p 27–44 refs (See N67-26791 14-33)

The rate at which heat can be transferred through a given heat pipe may be limited by one or more of the following considerations: evaporator heat transfer area; condenser heat transfer area; and capacity of the capillary pump. Reported are studies concerned with heat pipes limited by the last of these considerations. An analytical model of the heat pipe is presented. The model, based upon basic mass, energy, and momentum balances, is solved to yield an expression for the maximum heat transfer rate. Experiments resulting in data suitable for testing this model are described and, the close agreement between analysis and experiment is demonstrated. Author

N67-26795# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FEASIBILITY STUDIES OF SPACE RADIATORS USING VAPOR CHAMBER FINS
H. C. Haller and S. Lieblein *In* Sandia Corp. Proc. of Joint AEC/Sandia Lab. Heat Pipe Conf., Vol. I Oct. 1966 p 47–67 refs (See N67-26791 14-33)

The objective of this paper is to present some results of feasibility studies of space radiators incorporating vapor chamber

fins, as intended for application to Rankine system power plants. Included in the presentation are: (1) a comparison of the weight and geometry characteristics of several vapor-chamber-fin and conducting-fin radiators; (2) an indication of the sensitivity of vapor-chamber radiator weight to capillary flow variables; (3) a compilation of capillary internal-flow requirements; and (4) a discussion of anticipated problem areas. S.C.W.

N67-26796# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NOTES ON HEAT PIPES AND VAPOR CHAMBERS AND THEIR APPLICATION TO THERMAL CONTROL OF SPACECRAFT

S. Katzoff *In* Sandia Corp. Proc. of Joint AEC/Sandia Lab. Heat Pipe Conf., Vol. I Oct. 1966 p 69–89 refs (See N67-26796 14-33)

Reviewed are studies concerning heat pipes and vapor chambers that were made relative to design studies of large orbiting telescopes. Discussed are studies focusing on: (1) The use of heat pipes to improve the temperature uniformity of the skin around a large cylindrical spacecraft. (2) The use of a small tube, or artery, to convey the liquid over long distances instead of depending on the wick proper. (3) Means of metallically bonding a screen wick to a wall in order to minimize the temperature difference between the wall and the liquid surface. (4) The relation of screen dimensions and construction to the suction available with it. (5) The general problem of verifying the operation of a heat tube or vapor chamber by means of tests in the laboratory 1-g environment. Also cited are areas where further developments would be useful. S.C.W.

N67-26899# RAND Corp., Santa Monica, Calif.

THE THERMODYNAMICS OF THE CALCIA/CALCIUM–OXYGEN VAPOR SYSTEM

F. J. Krieger Jan. 1967 36 p refs

(Contract F44620-67-C-0045; Proj. RAND)

(RM-5248-PR; AD-648525) CFSTI: HC$3.00/MF$0.65

The purpose of the study is the thermodynamic investigation of calcia, CaO, over a range of temperatures up to 6000K and pressures up to 1000 atmospheres. Two sets of equilibrium composition equations are used--one representing a pure gas phase, the other a heterogeneous system of gas and condensed (i.e., solid or liquid) calcia. The gas phase of the heterogeneous chemical system, like the homogeneous gas phase, comprises 9 gaseous calcium-oxygen species. The results of the computational program are presented in both tabular and graphic form. The latter is a conventional Mollier diagram in which specific enthalpy is plotted against specific entropy, with cross plots of temperature, pressure, and molecular weight or moles of condensed calcia. Author (TAB)

N67-27227*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

STUDY OF CHUGGING INSTABILITY WITH LIQUID-OXYGEN AND GASEOUS-HYDROGEN COMBUSTORS

Marcus F. Heidmann, Daniel E. Sokolowski, and Lawrence A. Diehl Washington, NASA, Jun. 1967 41 p refs

(NASA-TN-D-4005) CFSTI: HC$3.00/MF$0.65 CSCL 21B

Instability boundaries for a small-scale, liquid-oxygen and gaseous-hydrogen combustion system were experimentally determined over a broad range of operating conditions to establish quantitatively the effect of combustion-system variables. Parallel-jet injection of oxygen into diffusely injected hydrogen was used. Variables included the characteristic combustor length and, for the oxygen system, the number of jets, injector orifice length to diameter ratio, flow-system volume, manifold pressure loss, and atomization mechanism. Results were compared by using the oxygen flow-system pressure drop and the range of stable operation as criteria. Results were evaluated with the aid of an analytical model that characterizes the combustion process by a time lag and an interaction index. The stability behavior of the combustor system was found to be insensitive to the response time of the oxygen flow system. Gas entrainment in liquid oxygen due to local cavitation and/or heat transfer was identified. An empirical equation based on typical jet-breakup behavior was formulated to give time-lag variations over a range of combustor conditions. Author

N67-27237*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FREQUENCY RESPONSE OF A FORCED-FLOW SINGLE-TUBE BOILER

Robert G. Dorsch Washington, NASA, 1967 21 p refs To be presented at Symp. on Two Phase Flow Dyn., Lindhoven, The Netherlands, 4–9 Sep. 1967

(NASA-TM-X-52306) CFSTI: HC$3.00/MF$0.65 CSCL 13A

Experiments were performed with a pump-fed single-tube heat exchanger boiler employing Freon 113 as the boiling fluid and hot water as the heating fluid. An electro-hydraulic servo-valve was used to impose quasi-sinusoidal perturbations on the mean flow into the boiler. Frequencies between 0.04 and 4 Hz were employed. Inlet pressure and flow perturbations were measured. A transfer function analyzer was used to obtain the amplitude and phase of each pressure and flow response. Boiler inlet impedance as a function of frequency was determined for a variety of steady state operating conditions. Primary steady state variables were heat flux and exit quality. Data were obtained with two boiler tube configurations: a hollow tube, and a tube with a spring-plug insert to turbulate the flow. The boiler inlet impedance plots indicate that feed-system coupled instabilities will occur at many of the steady state operating conditions if sufficient feed-system stabilization is not provided. The impedance data provide a measure of the amount of feed system stabilization needed. The data also can be used to predict the frequency at which a given system will go into natural oscillation. Author

N67-27268*# Toronto Univ. (Ontario).

THE USE OF SELF-CALIBRATING CATALYTIC PROBES TO MEASURE FREE-STREAM ATOM CONCENTRATION IN A HYPERSONIC FLOW

N. M. Reddy Washington, NASA, May 1967 92 p refs

(Grant NsG-633)

(NASA-CR-780) CFSTI: HC$3.00/MF$0.65 CSCL 01A

A technique is presented to measure simultaneously the catalytic efficiency (ϕ_c) and the free stream atom concentration (α_∞) in a hypersonic flow of dissociated gas. The principle involved is to measure the differential heat transfers by using, either a combination of axisymmetric and two-dimensional, differential catalytic probes, or two geometrically similar, differential catalytic probes mounted side by side in a uniform, dissociated, hypersonic free-stream. Using these measured quantities in the appropriate stagnation point heat transfer relations for a frozen flow, simple formulae for ϕ_c and α_∞ are derived. The practical feasibility of this technique has been successfully demonstrated by measuring the gauge catalytic efficiency of a silver surface and the free-stream oxygen atom concentrations in the UTIAS 11 in.×15 in. Hypersonic Shock Tunnel test section. The free-stream atom concentration α_∞ was measured at five reservoir conditions (14.2 atmos. $\leq P_0 \leq$ 40.7 atmos., 4530°K $\leq T_0 \leq$ 4700°K., 0.54 $\geq \alpha_0 \geq$ 0.32) and varied from 0.30 to 0.16. The measured values of α_∞ compared favourably with those computed from coupled vibrational and dissociational nonequilibrium nozzle flow calculations carried out by Tirumalesa. Author

N67-27286*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL EVALUATION OF HIGH-PURITY-SILICA REINFORCED ABLATIVE COMPOSITES AS NOZZLE SECTIONS OF 7.8-INCH-(19.8 CM) DIAMETER THROAT STORABLE-PROPELLANT ROCKET ENGINE

Donald A. Peterson Washington, NASA, Jun. 1967 28 p refs
(NASA-TM-X-1391) CFSTI: $3.00 CSCL 21H

Eleven high-purity-silica reinforced ablative materials were evaluated as nozzle sections of a storable propellant (nitrogen tetroxide and a blend of 50% unsymmetrical dimethylhydrazine and 50-percent hydrazine) rocket engine. Testing was performed at an oxidant-to-fuel ratio of 2.0, a chamber pressure of 100 psia (689 kN/m^2) and an initial throat diameter of 7.82 inches (19.8 cm). Both oxidant-to-fuel ratio and chamber pressure were maintained constant during the test firing at an equivalent pressure altitude of 1.60 psia (11.05 kN/m^2). Erosion rates, char information, and a discussion of the effect on erosion of some major material and processing variables are presented. Author

N67-27311*# National Aeronautics and Space Administration, Washington, D. C.
CONTRIBUTION TO THE CALCULATION OF TEMPERATURE DISTRIBUTION ON A POROUS PLATE [K RASCHETU RASPREDELENIYA TEMPERATURY NA PORISTOY PLASTINE]
S. A. Druzhinin and A. I. Leont'yev May 1967 5 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 10, no. 4, 1966 p 479–481
(NASA-TT-F-10959) CSCL 20M

Based on previously obtained relations for the wall temperatures of a porous plate exposed to turbulent flow of compressible gases, a diagram is proposed for easy calculation of the temperature distribution along a porous plate with uniform injection of gas. It is shown that the wall temperature distribution $T_w = f(X)$ can be predicted by a function F_1 (which is given). The formulas, using the energy equation and heat transfer laws, are compared with experimental data for a plate at a gas velocity U = 1 and a mean cross section of X = 0.5 at high Reynolds numbers. Author

N67-27312*# National Aeronautics and Space Administration, Washington, D. C.
THE TEMPERATURE FIELD IN AN INFINITE PLATE HEATED SIMULTANEOUSLY BY RADIATION AND CONVECTION [TEMPERATURNOYE POLE V NEORGANICHENNOY PLASTINE NAGREVAYMOY RADIATSIYEY I KONVEKSIYEY ODNOVREMENNO]
Yu. V. Vidin and V. V. Ivanov May 1967 6 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 4, 1965 p 3–6
(NASA-TT-F-10960) CSCL 20M

A relatively simple approximate method of calculating the temperature field in an infinite plate, heated simultaneously by radiation and convection, is developed. Numerical values are given for the case of Sk = 0.4, Bi = 0.5, and $\theta_0 = 0.2$. A computational check of the proposed equations showed the error to be less than 10% for Sk = 1.0 and Bi = 1.0; the accuracy of the method increases with decreasing Sk and Bi. Author

N67-27333# Toegepast Natuurwetenschappelijk Onderzoek Rijswijk (Netherlands).
RESEARCH ON THE INFLUENCE OF CONDITIONS OF FLOW, SUBCOOLING, AND COMPOSITION ON THE BURNOUT HEAT FLUX OF POLYPHENYL REACTOR COOLING AGENTS
D. A. van Meel and M. L. G. van Gasselt 6 Jun. 1966 50 p
(EUR-3120.e)

Research on forced convection non-boiling, subcooled boiling and subcooled burnout heat transfer and pressure drop of terphenyl mixtures in vertical test sections is summarized. Recommended correlations are presented for heat transfer and pressure drop, for upflow through the round 5 mm vertical tube, 500 mm in length. Author (NSA)

N67-27348# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Physics.
HEAT TRANSFER IN SEVEN-ROD CLUSTERS. INFLUENCE OF LINER AND SPACER GEOMETRY ON SUPERHEAT FUEL PERFORMANCE
H. J. Hoffmann, C. W. Miller, G. L. Sozzi, and W. A. Sutherland Oct. 1966 97 p refs
(Contract AT(04-3)-189)
(GEAP-5289) CFSTI: HC $3.00/MF $0.65

The general problem of heat transfer in an array of seven rods is considered. Heat transfer, pressure drop, velocity, and temperature distribution measurements were made with air flow (Pr = 0.7) past electrically heated rods. Two liner geometries were investigated, circular and scalloped shaped, with rod center-to-center spacing to rod diameter ratios of 1.141 and 1.237. Rod alignment and spacing were maintained by small pin-type spacers, grid-type spacers, or wire-wrap spacers. The data obtained over a Reynolds number range of 5,000 to 150,000 provided the engineering information necessary for optimization of heat transfer performance in nuclear superheat fuel elements. Author (NSA)

N67-27465# Minnesota Univ., Minneapolis.
TRANSPIRATION COOLING OF A CONSTRICTED ELECTRIC-ARC HEATER Technical Report, Jun. 1964–Dec. 1965
J. E. Anderson Wright-Patterson AFB, Ohio, ARL, Aug. 1966 133 p refs
(Contract AF 33(657)-7380)
(ARL-66-0157; AD-648254) CFSTI: HC $3.00/MF $0.65

A theoretical study has been made to estimate the potentialities of a constricted-arc gas heater in which the wall of the constrictor tube is transpiration cooled. By use of an integral form of the energy equation, it is found that the mass-average enthalpy reaches a maximum value in a distance, in tube diameters, of about half the ratio of the initial axial mass flux to the radial mass flux of the transpiring gas. When compressibility effects are small, the maximum is an asymptotic state. For this state the conservation equations are reduced to ordinary differential equations which are solved numerically for the case of hydrogen at atmospheric pressure. The graphical results show the relationship between blowing rate, power input, wall temperature, peak temperature, average enthalpy, electric field and current, and also distributions of various dependent variables. The range in which the solution is valid is determined from calculations of axial and radial pressure variations, Mach number, axial Reynolds number, and of the minimum blowing rate. From these considerations one can predict that a peak temperature of about 60,000K should be obtainable, but that the maximum mass-average enthalpy will be about the same as that obtainable from a water-cooled arc. Some results are presented to show the sensitivity of the solution to changes in the electrical conductivity, the radiated power and the radial velocity profile. TAB

N67-27615*# Auburn Univ., Ala. Dept. of Mechanical Engineering.
POOL BOILING OF WATER ON 304 STAINLESS STEEL ETCHED WITH HYDROCHLORIC ACID
R. I. Vachon, G. E. Tanger, G. H. Nix, and L. H. Gores Aug. 1966 28 p refs
(Contract NAS8-11234)
(NASA-CR-84467; Rept.-6) CFSTI: $3.00 CSCL 20M

Data for pool boiling water from 304 stainless steel surfaces etched with hydrochloric acid are presented. The Rohsenow equation is used to correlate the data, and new values of C_{sf} and exponent r for the correlation are given. The difficulties in comparing data for pool boiling are discussed, and the role of rms surface roughness as well as preparation technique for surface description is discussed and emphasized. Author

N67-27540*# International Information, Inc., Philadelphia, Pa.
HEAT EXCHANGE IN FUEL ELEMENTS OF LIQUID-METAL COOLED REACTORS [TEPLOS'YEM V ELEMENTAKH REAKTOROV S ZHIDKO-METALLICHESKIM OKHLAZHDENIYEM]
V. I. Subbotin, P. A. Ushakov, P. L. Kirillov, M. Kh. Ibragimov, M. N. Ivanovskiy et al Mar. 1967 16 p refs Transl. into ENGLISH from Proc. of the 3d Conf. on Peaceful Uses of Atomic Energy Paper No. 328 Presented at the United Nations, Geneva, 31 Aug.–9 Sep. 1964 p 192–203
(Contract NASw-1499)
(NASA-TT-F-10776) CFSTI: HC $3.00 CSCL 20M

The paper presents new data on heat transfer in liquid metals obtained in recent years during the development of liquid-metal cooled reactors. By means of temperature gradient measurements in flow systems containing sodium, sodium–potassium alloy, lithium, and mercury a general equation for the temperature distribution in different liquid-metals has been obtained. Turbulent flow heat transfer coefficients in pipes have been determined along with some statistical properties of turbulent flow. Data have been obtained which relate the heat transfer and temperature distribution to the channel geometry and to the thickness and thermal conductivities of both the fuel layer and the cladding. It is shown that the mean heat transfer coefficient in heat exchangers and in fuel element banks must differ from each other. Author

N67-27612*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HEAT-TRANSFER AND TEMPERATURE DISTRIBUTION OF A CONICAL POROUS MEMBRANE DURING PLANETARY ENTRY
Latif M. Jiji Washington, NASA, Jun. 1967 32 p refs
(NASA-TN-D-4019) CFSTI: $3.00 CSCL 20M

An approximate analysis is made of the stagnation point heating rate and surface temperature of a conical porous membrane used as a decelerator during planetary entry of vehicles of low ballistic parameter. Ideal gas approximations were used. Order of magnitude variations of the porosity and ballistic parameter, as well as variations in cone angle, were made to find their gross effect on the wall temperature of the membrane. Also, the wall temperature was determined for an order of magnitude variation in the distance rearward along the membrane from the stagnation point. Porosity was found to have an adverse effect on the wall temperature. To avoid high wall temperatures it was necessary to use unrealistic values of ballistic parameter and cone angle. Author

N67-27667*# North Dakota Univ., Grand Forks.
TIME-TEMPERATURE CHARACTERISTICS OF THIN-SKINNED MODELS AS AFFECTED BY THERMOCOUPLE VARIABLES Semiannual Report
Milton B. Larson 15 May 1967 18 p
(Grant NGR-35-002-003)
(NASA-CR-84500; SAR-4) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Because an exact solution of the two wire problem appears to be beyond the scope of this project, an attempt was made to determine if the solution already obtained for the case of two semi-infinite sheets butted to an infinite sheet could be used to approximate such a solution. Solutions for the single simple wire and the single sheet junction were compared in terms of the dimensional variables. The comparison indicates that the solutions will be identical when the wire radius is equal to the thickness of the plane sheet. This suggests that the two sheet solutions may be used to understand the two wire problem by replacing the sheet thicknesses with the radii of the wires. There is no proof that this procedure leads to a correct solution, but based on the physics of the problem, such a solution is felt to be of value, at least along the line joining the two wires. Several errors and omissions in the previous report are mentioned. R.N.A.

N67-27668*# North Dakota Univ., Grand Forks.
A MATHEMATICAL INVESTIGATION OF A HEAT TRANSFER CONFIGURATION
Paul G. Nelson (M.S. Thesis) Jun. 1967 40 p
(Grant NGR-35-002-003)
(NASA-CR-84503) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The Laplace transform and the inverse Laplace transform are defined along with a brief discussion of some of the properties of the Laplace transformation method and its use in solving systems of differential equations. Because the error function and Hermite polynomials appear throughout the thesis as a result of certain inversions, these functions are also defined. The problem of obtaining the temperature distribution in a thin skin to which a straight wire has been attached is considered. The effects of thermal resistance and extra capacity between the wire and the skin are evaluated. The extra capacity is taken into account by using a model where the wire is fastened along the skin for some length. As the thermal resistance and the length along which the wire is connected to the skin are decreased, the solution to this model approaches the solution to the straight wire model. Because the solutions to these heat conduction problems were found without nondimensionalizing the equations, appropriate substitutions are made to obtain solutions involving dimensionless parameters. R.N.A.

N67-27774# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
INFRARED REFLECTANCES OF METALS AT CRYOGENIC TEMPERATURES—A COMPILATION FROM THE LITERATURE
P. F. Dickson and M. C. Jones 14 Oct. 1966 65 p refs
(NBS-TN-348) GPO: $0.40

Spectral and total reflectances for metals at cryogenic temperatures in the infrared wavelength region are compiled from the literature. Information concerning sample preparation and purity, radiation source, and methods of reflectance measurement are also presented. Observations regarding the effects on reflectance of temperature, oxide layer, wavelength, and sample preparation are given. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N67-26510*# Indiana Univ., Bloomington.
[PLANNING, DEVELOPING AND TESTING EXPERIMENTAL TECHNOLOGY UTILIZATION PROGRAMS] Quarterly Report, Oct. 1–Dec. 31, 1966
31 Dec. 1966 15 p
(Contract NSR-15-003-032)
(NASA-CR-84154) CFSTI: HC $3.00/MF $0.65 CSCL 05A

An overview is presented on the joint programs undertaken by NASA and the Aerospace Research Applications Center (ARAC) to disseminate the technology developed by the space effort to the industrial community. Several transfer mechanisms are discussed in relation to small business experiments, real-time information retrieval, computer information service, industrial applications abstracts, and current awareness profiles. Participation by universities in ARAC's experimental program to assist academic scientists and graduate students with their technical needs is also discussed. Promotional activities are summarized, and a fee schedule on the available services is included. M.G.J.

N67-26601# Illinois Univ., Urbana. Coll. of Engineering.
THE SUMMARY OF ENGINEERING RESEARCH, 1966
Ursula Weise, ed. 2 Nov. 1966 220 p refs *Its* Univ. of Ill. Bull., Vol. 64, No. 37
Available from Ill. Univ., Urbana: $5.00

CONTENTS:

1. AERONAUTICAL AND ASTRONAUTICAL ENGINEERING p 7–16 refs (See N67-26602 14-34)
2. AGRICULTURAL ENGINEERING p 17–25 refs
3. CERAMIC ENGINEERING p 27–32 refs (See N67-26603 14-18)
4. CHEMICAL ENGINEERING p 33–38 refs (See N67-26604 14-06)
5. CIVIL ENGINEERING p 37–77 refs
6. COORDINATED SCIENCE LABORATORY p 79–86 refs (See N67-26605 14-10)
7. ELECTRICAL ENGINEERING p 87–110 refs (See N67-26606 14-10)
8. GENERAL ENGINEERING p 111–116 refs (See N67-26607 14-15)
9. MECHANICAL AND INDUSTRIAL ENGINEERING p 117–131 refs (See N67-26608 14-15)
10. MINING, METALLURGY, AND PETROLEUM ENGINEERING p 133–146 refs (See N67-26609 14-26)
11. NUCLEAR ENGINEERING p 147–156 refs (See N67-26610 14-22)
12. PHYSICS p 157–181 refs (See N67-26611 14-23)
13. THEORETICAL AND APPLIED MECHANICS p 183–194 refs (See N67-26612 14-32)
14. MATERIALS RESEARCH LABORATORY p 194–198 refs
15. COMPUTER SCIENCE p 199–203 refs (See N67-26613 14-08)
16. RELATED RESEARCH ORGANIZATIONS AND SERVICES p 205–207

N67-26602# Illinois Univ., Urbana. Coll. of Engineering.
AERONAUTICAL AND ASTRONAUTICAL ENGINEERING
In its Sum. of Eng. Res., 1966 2 Nov. 1966 p 7–16 refs (See N67-26601 14-34)

Engineering developments are summarized under the general areas of aerodynamics, astrodynamics, propulsion, structural mechanics, and flight vehicle dynamics. These include wind tunnel testing, plasma diagnostics, laminar and turbulent mixing, rarefied gas flows, detonation and wave propagation, rocket exhaust plumes, propellant materials, and structural dynamics. R.LI.

N67-26902# Office of Aerospace Research, Washington, D. C.
AIR FORCE RESEARCH OBJECTIVES, 1967
Sep. 1966 72 p
(OAR-607-1; AD-648379) CFSTI: HC $3.00/MF $0.65

Contents: Research proposals; OAR organization; Research objectives: Physical sciences (General physics, Nuclear physics, Chemistry, Mathematical sciences), Engineering sciences (Electronics, Materials research, Mechanics, Energy conversion), Environmental sciences (Terrestrial sciences, Atmospheric sciences, Astronomy and astrophysics), Life sciences (Biological and medical sciences, Behavioral and social sciences). TAB

N67-27206 Joint Publications Research Service, Washington, D. C.
UNDERWATER SHIPS OF SCIENCE
M. A. Rudnitskiy 5 Apr. 1967 9 p Transl. into ENGLISH from Tek.—Molodezhi (USSR), no. 7, 1966 p 5–6
(JPRS-40527; TT-67-31171) CFSTI: $3.00

Several questions pertaining to the design requirements and construction of deep-diving research vessels are considered. Submersion depths are identified as a prime factor in building underwater ships for specialized missions, and it is suggested that three types of vessels be developed for exploring the continental slope, the ocean bed, and trenches for submersion at depths of 2000, 6000, and 11,000 meters. The advantages and disadvantages of bathyscaphes are pointed out, and the need of developing new materials is discussed. The deep-diving vessel of the future is visualized as consisting of a streamlined external hull made of glass fiber reinforced plastic and several durable spheres or cylinders made of a weldable steel alloy. M.G.J.

N67-27296*# National Aeronautics and Space Administration. Washington, D. C.
CUMULATIVE INDEX TO NASA TECH BRIEFS, 1963–1966
Feb. 1967 166 p refs
(NASA-SP-5032I (04)) CFSTI: HC $3.00/MF $0.65 CSCL 13

Technological innovations published in NASA Tech Briefs between 1963 and 1966 are presented in a cumulative index. Short abstracts are included for each of the tech briefs under the five major categories of *Electrical (Electronic), Physical Sciences (Energy Sources), Materials (Chemistry), Life Sciences,* and *Mechanical.* An alphabetized subject index is included, as are an originator/tech brief number index and a tech brief/originator number index. M.W.R.

N67-27379*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.
MULTIDISCIPLINARY RESEARCH LEADING TO UTILIZATION OF EXTRATERRESTRIAL RESOURCES Quarterly Status Report, Jan. 1–Apr. 1, 1967
1 Apr. 1967 40 p refs
(NASA Order R-09-040-001)
(NASA-CR-84424) CSCL 22A

A compilation of progress reports from multidisciplinary research leading to the utilization of extraterrestrial resources is presented. Topics covered include such areas as the selection and sample collection of simulated lunar materials, physical properties of simulated lunar materials, chemical reactivity and cold welding of freshly formed surfaces, surface properties of lunar rock, fracture and other failure mechanisms in lunar environment, lunar drilling, underground lunar shelter, explosive properties, explosive blast effects in a lunar environment, and magnetic and electrostatic properties of minerals in a vacuum. C.T.C.

N67-27396 Joint Publications Research Service, Washington, D. C.
FRENCH BATHYSCAPE DEPARTS FOR JAPAN
Bernard Dimont 27 Apr. 1967 9 p Transl. into ENGLISH from Air et Cosmos, Paris, no. 190, Mar. 1967 p 22–23
(JPRS-40791; TT-67-31434) CFSTI: $3.00

The bathyscape Archimedes, scheduled to sail from Toulon for Japan, and its electronic equipment, are described. The cruise will test the technical improvements made for this type of vessel at great depths. The vessel is designed to carry passengers into the great depths. It should be able to explore the Challenger Deep near Guam in the Mariannas at 11,200 meters which surpasses the record descent of 10,800 meters held by the Trieste. Improvements envisioned for the Archimedes are listed. L.S.

N67-27676*# Pittsburgh Univ. Pa. Knowledge Availability Systems Center.
SPACE AND TECHNOLOGY TRANSFER PROGRAM Annual Report
May 1967 84 p
(Contract NASr-234)
(NASA-CR-84508; AR-3) CSCL 05B

The regional dissemination center established at the University of Pittsburgh (at the Knowledge Availability Systems Center) has

completed three years of operation. The organization consists of a trained cadre of engineering consultants and full time Center Staff, now serving sixty-four companies in the Northeastern part of the United States. Center operations have been formalized to the point at which a predictive model could be developed leading to the conclusion that self-support may be achieved with an increase in fees of approximately 50% with approximately twice the current number of member companies. Accordingly, a new fee structure is being implemented, and marketing activities augmented to increase company membership. Author

Collections of NASA Documents

NASA is depositing its technical documents and bibliographic tools in eleven Federal Regional Technical Report Centers. Each center, located in one of the organizations listed below is prepared to furnish the general public such services as personal reference, interlibrary loans, photocopy service, and assistance in obtaining retention copies of NASA documents.

California: University of California, Berkeley
Colorado: University of Colorado, Boulder
District of Columbia: Library of Congress
Georgia: Georgia Institute of Technology, Atlanta
Illinois: The John Crerar Library, Chicago
Massachusetts: Massachusetts Institute of Technology, Cambridge
Missouri: Linda Hall Library, Kansas City
New York: Columbia University, New York
Pennsylvania: Carnegie Library of Pittsburgh
Texas: Southern Methodist University, Dallas
Washington: University of Washington, Seattle

NASA publications are currently being forwarded to the public libraries in the cities listed below:

California: Los Angeles and San Diego
Colorado: Denver
Connecticut: Hartford
Massachusetts: Boston
Michigan: Detroit
Minnesota: St. Paul and Minneapolis
Missouri: Kansas City and St. Louis
New Jersey: Trenton
New York: Brooklyn, Buffalo, Rochester and New York
Ohio: Cleveland, Cincinnati, Dayton, Toledo and Akron
Oklahoma: Oklahoma City
Tennessee: Memphis
Texas: Fort Worth and Dallas
Washington: Seattle
Wisconsin: Milwaukee

In addition, NASA regularly sends its publications to the Enoch Pratt Free Library located in Baltimore, Maryland and the Wilmington Institute Free Library, Wilmington, Delaware.

An extensive collection of NASA and NASA-sponsored scientific and technical publications available to the public for reference purposes is maintained at the Technical Information Service, American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, New York 10017.

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

TECHNICAL REPORTS: Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

TECHNICAL NOTES: Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons.

CONTRACTOR REPORTS: Scientific and technical information generated under a NASA contract or grant and considered an important contribution to existing knowledge.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

TECHNOLOGY UTILIZATION PUBLICATIONS: Information on technology used by NASA that may be of particular interest in commercial and other non-aerospace applications. Publications include Tech Briefs, Technology Utilization Reports and Notes, and Technology Surveys.

Details on the availability of these publications may be obtained from:

SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546